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THE EMBRYOLOGIC ORIGIN OF CLUB-FOOT

From the Krüppelfürsorgestelle of the City of Berlin in St. Hildegard's Hospital

BY REGIERUNGS-MEDIZINALRAT DR. MAX BÖHM, BERLIN, GERMANY

Director of the Krüppelfürsorgestelle

TRANSLATED FROM THE GERMAN BY W. P. BLOUNT, M.D., MILWAUKEE, WIS.

GENERAL INTRODUCTION

I am particularly glad to accept the invitation of the Editor of this *Journal* to contribute material, because I feel that there is a deficiency in the field of scientific orthopaedic surgery relative to the question of the origin of deformities and their pathologic anatomy. I have been occupied with this problem for the last few years, and expect to continue with it in the future. One who has been intensely interested in this subject and who has studied the literature of Orthopaedic Surgery since the department was established, cannot escape the impression that investigation has been diverted in a direction which has led us into a blind alley. To suit the peculiarities of our specialty we have stretched a point to explain the origin of deformities on a *mechanical* basis, so to speak,—to derive the abnormal curves mathematically. It is not permissible, in my estimation, to hastily establish in this way satisfactory explanations for the origin of spinal curvature, knee deformities, nor for the malformations of the foot. It would be easy to offer destructive criticism of all of the theories which have been previously advanced for the explanation of these deformities of childhood. But in this paper these criticisms will be omitted and positive evidence produced in the support of an anatomic, biologic explanation in opposition to the mechanical theory. A discussion of congenital club-foot is presented in the following pages. In the succeeding articles of the series I hope to be able to give the results of the investigation of infantile pes valgus, and deformities of the knee and hip.

SPECIAL INTRODUCTION

Many writers of modern and ancient times hold the view that congenital club-foot is a mechanical deformity,—*i.e.*, that it is caused by external forces which bring the foot into the faulty position during its development. Among these extrinsic mechanical factors the pressure of the uterine wall, the foetal membranes, etc., have been suggested.

This theory is opposed by another which holds that the formation of a club-foot is an endogenous maldevelopment,—that is, a primary disturbance of the embryo. The question as to which theory is correct is not only of scientific but also of the greatest practical importance. For if one is to treat the deformity as a secondary, mechanically created one, he must admit that the individual elements of the foot are normally fashioned and only deformed in a mechanical way from the outside. One must admit, moreover, that such a deformity is comparatively easy to overcome.

On the other hand, if a club-foot develops primarily endogenously, it is possible, or even probable, that the individual component bones of the foot are not morphologically normal in their primary development. The individual bones, joints, muscles, etc., may here exhibit from the first an entirely abnormal conformation, and it is clear that under the circumstances of this last case the correction of the external deformity is essentially more difficult than in the first.

Of course there is the possibility that both theories are correct and that both causes of the deformity operate side by side. But even then the problem is not solved, and we are faced with the question of the *quantitative* importance of etiology and pathology in one as opposed to the other case.

For half a century individual writers, such as Hueter and von Volkmann, have regarded congenital club-foot as the result of an arrest of development,—that is, as a malformation in the sense that in one of the physiologic developmental phases of its embryonic life the foot remained stationary. Until the present time, no one has been able to verify this conception. A comprehensive monograph by Bessel-Hagen on club-foot appeared at the end of the last century. This writer took up a large series of investigations of embryonic feet and on the basis of these studies opposed the theory that in embryonic life there was normally a stage in which the foot assumed the physiologic form of a club-foot. Hoffa accepted Bessel-Hagen's research as sound, and incorporated the findings and conclusions in his textbook. On Hoffa's authority, most of the younger writers turned at once to the Bessel-Hagen theory. In this generation, for example in the monograph of Mau, we find the opinion expressed that congenital club-foot can not be due to an arrest of skeletal development, because its anatomic appearance does not resemble the physiologic form of the embryonic foot. In particular, Mau writes, *"The embryonic foot does not show the distortion of the bones about the tarsal (Chopart's) joints*

which is found in a club-foot". So Mau reverts to the older muscular theories which consider congenital club-foot to be a neuromuscular contracture (Duverney, Guérin, Stromeyer, and others). That opened again the question: Is the fundamental cause of club-foot to be sought in the skeleton or in the soft tissues? This question seemed settled long ago, after Hoffa had expressed himself in his textbook as follows: "The deformity involves the entire combination of bones which make up the skeleton of the foot. All changes that we see in the soft parts are of a secondary nature."

To more nearly approach a solution of the disputed question, it is first necessary to decide whether or not at any stage in the embryologic development of the foot, physiologic positions are evolved which are identical with or have something in common with "club-foot".

THE EVOLUTION OF THE FOOT IN THE FIRST HALF OF PRENATAL LIFE

In comparing the forms of congenital club-foot with those assumed in the physiologic embryonic development of the foot, the construction of wax-plate models was particularly valuable. The skeleton of the embryonic foot was reconstructed on the basis of serial sections which were reproduced on a larger scale on wax plates. These were then assembled and fused.

TABLE I

No.	Length, Vertex to Buttocks	Age	Method of Investigation	Illustration
I	14 mm.	About 5 weeks	Photography, microscopy	Fig. 2
II	18 mm.	About 6 weeks	Wax-plate model	Figs. 3–5
III	23 mm.	About 9 weeks	Photography, wax-plate model	Figs. 7–11
IV	35 mm.	Middle of third month	Photography, microscopy, wax-plate model	Figs. 12–16
V	57 mm.	End of third month	Photography	Fig. 17
VI	90 mm.	Middle of fourth month	Wax-plate model	Figs. 18–19

It seems wise for the writer to limit himself here to the first half of embryonic life, and of the many feet of that period that were studied, describe those of six embryos. These were carefully prepared by fixing in formalin, and the production of deformities in handling was painstakingly guarded against. Almost all of them were studied macroscop-

ically with the aid of photographic enlargements. Sections were cut from some in special planes and studied microscopically. In four cases, wax-plate models were constructed.

It is not within the province of this paper to describe the embryologic development of the bones of the human foot from all morphologic aspects, and much less so, in that Henke and Reyher, Schomburg, Bardeen, and others have treated this subject thoroughly. At present the problem of most importance is to point out the position of the foot in its relation to the lower leg; the relation of the component elements to each other during development; and in a measure to present the orthopaedic point of view.

First Stage

An enlarged photograph (Fig. 1) of one of the embryos of seventeen millimeters examined by the author shows the limb bud which is characteristic of the first stage. The division into thigh and lower leg is determined by the protrusion of the knee, which points laterally and slightly dorsally. The thigh and knee portion are in marked outward rotation.

FIG. 1
A side view of an embryo of 17 mm.

The foot plate is separated from the leg by a slight constriction. Its dorsal aspect is turned laterally and the plantar, medially. The plane of the plantar surface is such that, if extended on the little-toe side, it would intersect the median sagittal plane of the body at an acute angle. The foot plate is also turned into slight supination. This foot part is a direct extension of the lower leg in its long axis,—that is, the mediolateral (craniocaudal) breadth of the lower leg lies in the same plane as the foot plate.

The formation of separate digits is not yet definite. Microscopic study of the lower extremity discloses no obvious differentiation as yet.

The embryo of fourteen millimeters (Embryo I), presumably in the fifth week, shows macroscopically a limb bud which is similar to the one in Figure 1. Figure 2 is a longitudinal section

through the extremity. Here one can see the tibia for its entire length, and a part of the somewhat thickened fibula. The talus lies between the distal ends of these bones in a remarkably oblique position. Its axis runs from the fibula, proximally; toward the tibia, distally. Its medial distal corner lies near the medial malleolus. The navicular is distal to the talus and lies obliquely with its medial corner also near the medial malleolus. Still farther toward the toes are the three cuneiforms, which become progressively larger toward the lateral side. There is only denser tissue to represent the calcaneus and cuboid, no centers being visible in the section. This tissue lies distal to and in the longitudinal axis of the fibula, for which the anlage of the calcaneus forms a broad cap. The second to the fourth metatarsals are plainly visible and are adducted. The fifth is also present, and slightly adducted. The first is clearly represented only by its base, which is adjacent to the first cuneiform and the navicular. Although the distal portion consists only of dense tissue, the general position is seen to be one of marked adduction.

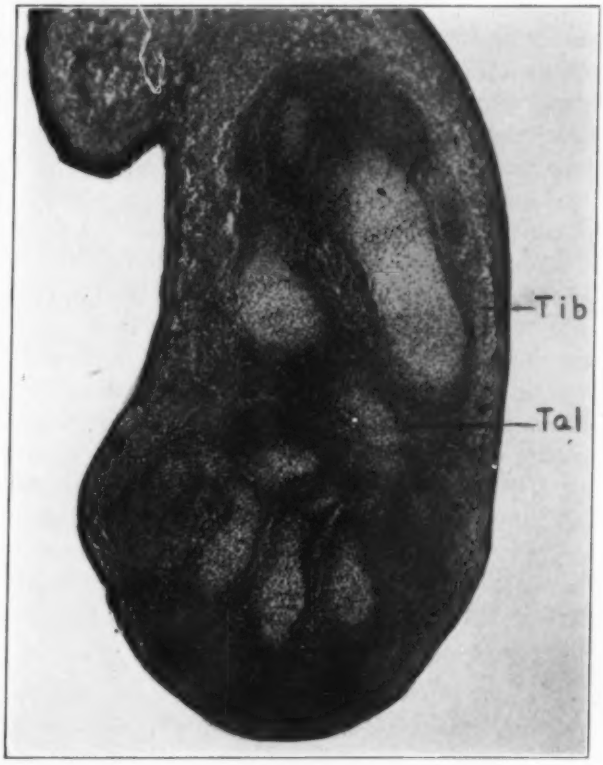

FIG. 2

Embryo I, 14 mm. long; photomicrograph of a longitudinal section through the left lower leg and foot.

The next embryo, of about six weeks (Embryo II), differs from the earlier one only in the more evident formation of digits by slight indentation of the surface, and by the separation of the first toe. The position of the foot plate has remained unchanged.

A wax-plate model was made of the skeleton of the entire lower limb, including the pelvis and a portion of the spine. The model was then photographed from the broad, front aspect of the lower leg, with the transverse axis of the knee horizontal. Figure 3 is a reproduction of the picture. In the lower leg one is struck by the massive proportions of the

fibula (Fib). The talus (Tal) extends to the tibia (Tib) and fibula, and runs very obliquely from lateral and proximal (the fibular side) to medial and distal. The somewhat smaller calcaneus (Calc) lies next to it on the lateral side and in a similar oblique position. Distal to this is the transversely placed navicular (Nav) which juts beyond the rest of the foot on the tibial side. The cuboid lies almost in the line of the fibula. The cuneiforms become progressively larger toward the fibular side. The metatarsals from the fifth to the second are progressively more deviated toward the tibia in a position of adduction. These metatarsals have become cartilaginous and so are reproduced in the model. The first exists only in connective tissue, but may be seen in the section (Fig. 5). Its proximal end is at the *medial* border of the first cuneiform, and it extends toward the tibial side of the foot plate into the preformed protuberance. It forms an angle of fifty degrees with the long axis of the foot, being in marked adduction.

The whole foot is as flat as a board and in the *same* plane as the lower leg, the plane through the transverse axis of the knee which in later life becomes the frontal plane. The photograph of the model from the tibial side (Fig. 4) shows this position clearly. The lateral condyle of the knee is behind the medial; the front of the knee faces anteriorly; and the tibia is superimposed on the fibula.

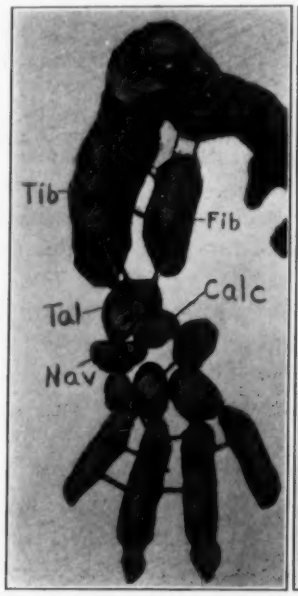

FIG. 3

Embryo II, 18 mm. long; photograph of the wax-plate model of the left lower leg and the foot from the front and dorsal sides respectively.

FIG. 4

Embryo II; photograph from the tibial side of the wax-plate model of the left lower leg and foot.

From the orthopaedic point of view, the skeleton of the foot in Embryos I and II is in the first stage. The form of the foot in these typical embryos of the second month is characterized by:

(1) A marked equinus with ninety degrees of plantar flexion beyond the position of the fully developed foot.

(2) Adduction, as a result of the medial inclination of the calcaneus and talus. The navicular is near the internal malleolus and the metatarsals are further adducted, the first making the extreme angle of fifty degrees with the long axis of the foot.

Inasmuch as it is difficult to establish a valid conclusion on the basis of the findings in two specimens, reference to the literature is advisable. The investigations of Henke and Reyher, Schomburg, and Bardeen are available for comparison. Henke and Reyher studied one embryo of about the second month; Bardeen, two; and Schomburg, six.

All of the writers confirmed the position of equinus. Schomburg illustrates the adduction with a diagram (Fig. 6-A). It should be noted that at this age the navicular is displaced somewhat medially on the talus and the cuboid is lying medial to the calcaneus. The heads of the metatarsals, and particularly of the first, are deviated medially.

It is true that Bardeen does not entirely agree to the position of the metatarsals as shown in Schomburg's diagram, but he emphasizes the approximation of the navicular to the internal malleolus. In a significant illustration (Fig. 6-B), his section of a very early embryo does demonstrate the existence of adduction of the tarsus and metatarsus.

According to Bardeen's description of the foot of an embryo of eighteen millimeters, the tibia is much thicker than the fibula, and extends farther distally. The talus has the form of a rhomboid, and runs from the fibular and dorsal to the tibial and plantar surface. The calcaneus is rather small and is in the line of the long axis of the fibula, but in a plane slightly plantar to this. The cuboid has the appearance of being a direct extension of the calcaneus; and similarly the navicular, a continuation of the talus. The tibial corner of the talus lies close to the distal end of the tibia. The three cuneiforms are relatively broader and thicker than in the fully developed skeleton. The metatarsals are separated less than in the earlier embryos (14 to 16 mm.).

In the embryo of twenty millimeters, Bardeen finds a remarkable change in the talus. It is considerably thicker, and extends beyond the calcaneus. Tibia and navicular which have lain close together are so separated by the elongation of the talus that now a much greater interval appears between them, and the foot is deflected to the fibular side. The long axis of the calcaneus extends from proximal to distal. The cuneiforms are closer together. The cuboid is larger.

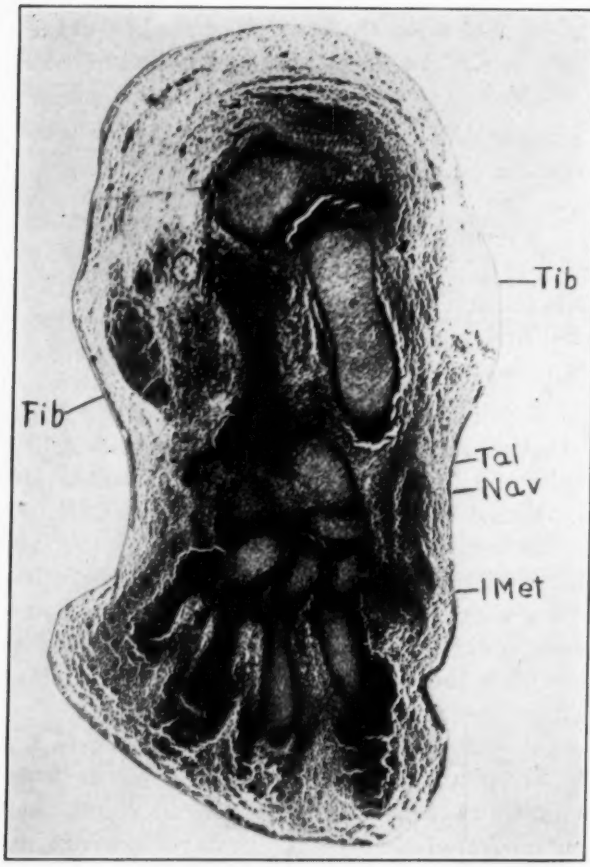

FIG. 5

Embryo II; photomicrograph of a section through the left lower leg and foot.

With the wealth of material furnished by his seven embryos of five to six weeks, Schomburg recorded the following findings: The fibula is more slender, the tibia thicker. A continuation of the long axis of the fibula, which in the fifth week still passes through the fifth metatarsal, at the beginning of the sixth week is at the fourth, and at the end of the sixth week at the third. The foot changes from a position of adduction toward one of abduction, — the process which Bardeen terms deviation to the fibular side, and attributes to the elongation of the talus. (The agreement of the two authors on this point is worthy of note.) The navicular is displaced markedly inward, so that it is in close relationship with the tibia. It is bounded proximally by the talus and distally by the three cuneiforms *and* the cuboid. During the sixth week the navicular, together with the distal tarsal bones (the cuneiforms and metatarsals) shift toward the lateral side. The cuboid lies on the extreme lateral side. The evolution of the proximal tarsal bones proceeds, meanwhile, as follows: In the fifth week the calcaneus is longer than the talus and both have only small articular surfaces. The principal articulations of the calcaneus are with the fifth metatarsal, the cuboid, and the fibula.

Bessel-Hagen, who opposed the "physiologic club-foot position" in other respects, reported that he found both plantar flexion and adduction developed in the tarsi of embryos of two months.

Leboucq's studies on the relationship in the embryo of the individual bones of the foot are worthy of mention. In a horizontal section he found that the head of the talus was sharply diverted toward the tibia. This

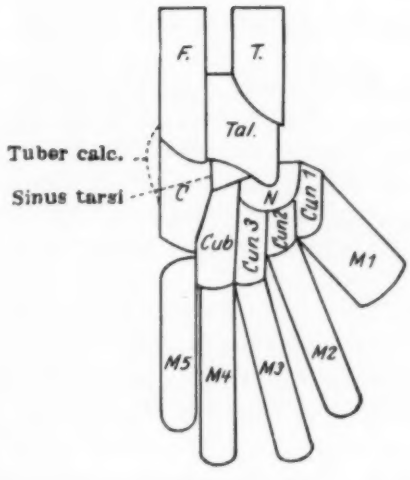

FIG. 6-A

Diagram of the foot of an embryo in the first half of the second month (From Schomburg).

FIG. 6-B

The left foot of an embryo in the first half of the second month (From Bardeen).

medial deviation explained, in part, the position of "abduction" of the whole tibial border of the foot and especially of the great toe. Lebouc q called this a movement from the long axis of the foot toward the mid-plane of the body. He distinctly observed the medial deviation of the first metatarsal in a human embryo of twenty-one millimeters.

Second Stage

When the embryo reaches a length of twenty millimeters, it is beyond the second month. Enlarged photographs were made of Embryo III, which a vertex-to-buttocks measurement of twenty-three millimeters places in the ninth week. Figure 7 shows the one taken from the side, and Figure 8 the one from the front.

In both plates one notices that the simple foot plate of the previous stage has undergone considerable differentiation. The toes are well developed. In the region of the heel a rounded protuberance is beginning to make its appearance, but is still to be considered minute as compared to its later development. The position of the foot is still the same as in the previous stage,—*i.e.*, in the line of the long axis of the lower leg. The adduction of the metatarsals and especially of the great toe still persists. However, *there is a new development in the rotation of the foot into a position of supination,* as is clearly shown in Figure 7.

Wax models of the cartilaginous skeleton demonstrate very clearly the underlying causes for the external form as shown in the photographs. In this case one was made of the entire skeleton of the limb including the pelvis.

Figure 9 shows the lower leg and foot of the model from directly in front, with the condyles facing forward. Figures 10 and 11 are lateral views from the tibial and fibular sides respectively. With the knee bent and the femur horizontal, a true side view of the condyles is obtained. The preparations were all photographed under conditions exactly similar to those prevailing in the model of Embryo II, so that Figures 9 to 11, and Figures 3 and 5 may be accurately compared.

The plates show that the bones of the foot, as in Embryo II, *lie in the line of the long axis of the leg*, but that a *rotation of the entire foot through ninety degrees has brought it into a position of supination.* The plane of the foot is perpendicular to the frontal plane of the lower leg (through the

FIG. 7

A side view of Embryo III, 23 mm. long.

FIG. 8

A front view of Embryo III, 23 mm. long.

transverse axis of the knee). This rotation is caused by a change in position of the tarsal bones.

The talus literally "stands on its head" and is in the line of the long axis of the lower leg. The proximal end is wedge-shaped and the areas in contact with the tibia and fibula are about equal (Fig. 9). The proximal part forms a projection on the plantar side which may be clearly seen behind (dorsal to) the internal malleolus in Figure 10. The cylindrical talus, which is still only slightly differentiated, is continued distally as the navicular, and—in the writer's preparation, at least—no distinct separation can be made out.

FIG. 9

Embryo III; photograph from the front of the wax-plate model of the left lower leg and foot.

In the transition from the first to the second stage, the most striking change has occurred in the calcaneus. From an earlier position of lateral apposition to the talus, it is now shifted down (plantarwards) so that in Figure 9, as seen from above, it is almost entirely obscured by the talus. Only a small area is visible on the lateral side. Coincident with the change of position, the calcaneus has undergone a change of form. A posterior process has developed on the proximal aspect. This is clearly evident in Figures 10 and 11. One can also see the increase in the area of apposition (joint) of the proximal part of the calcaneus with the *fibula*. Like the talus, the calcaneus is in the line of the long axis of the leg. Also, they both stand "upright" and deviate slightly to the tibial side, distally. The cuboid lies as an extension of the calcaneus with its medial proximal corner touching the navicular. The three cuneiforms lie at right angles to the transverse axis

FIG. 10

Embryo III; photograph from the tibial side of the wax-plate model of the left lower leg and foot.

FIG. 11

Embryo III; photograph from the fibular side of the wax-plate model of the left lower leg and foot.

FIG. 12
A side view of Embryo IV, 35 mm. long.

of the navicular. With its base at the tibial (medial) border of the first cuneiform, the first metatarsal is markedly adducted. The second to fourth metatarsals are slightly adducted.

It should be noted that the foot plate is no longer flat as in the previous stage. The medial and lateral borders are farthest plantarwards, forming an arch across the foot. This is present in the anterior tarsus and particularly in the posterior, with a suggestion of a curve in the metatarsus. The top of the foot forms a convexity and the sole a concavity. There is no definite longitudinal arch.

Bardeen also observed the formation of a transverse arch in embryos at the beginning of the third month.

From the orthopaedic point of view, at the beginning of the third month the embryonic foot goes through a second stage which is characterized by:

(1) a definite equinus of ninety degrees,
(2) marked supination, and
(3) adduction of the first metatarsal, and to a less extent of the other metatarsals.

Third Stage

Embryo IV; length, thirty-five millimeters; age, the middle of the third month.

This embryo (Fig. 12) shows outwardly a change from the previous one in that the foot has departed from the position of extreme equinus. By dorsiflexion in the region of the ankle joint the medial border of the foot has bent toward the lower leg and in the direction of the head. However, the equinus is not entirely lost, but exists to a milder degree. The same amount of supination persists as was present in the last, considerably earlier embryo. The first metatarsal and toe are adducted.

The digits are fully differentiated, and the balls of the toes are clearly seen. The tarsal region has decreased considerably in size, and the heel stands out distinctly. The sole of the foot shows the formation of a transverse arch.

A wax model of the skeleton of the extremity as far up as the middle of the femur was prepared, and this was photographed in the same way as those previously described.

The posterior (dorsal) view (Fig. 13) shows that the long axis of the lower leg is not perpendicular to the transverse axis of the knee, but crosses it at an angle,—that is, the distal part of the lower leg is angulated medially. In the same plate it is evident that the foot skeleton in toto is rotated into ninety degrees of supination. The lateral views from the tibial (Fig. 14) and fibular (Fig. 15) sides also show the marked supination of the foot. The most important difference from the preceding stage of development is also evident in these views. This is the dorsiflexion of the supinated foot along the medial border toward the lower leg. The talus and calcaneus are still in slight equinus, but the metatarsus and toes point over the medial border of the foot toward the head. As a result, there is an angle in the region of the navicular and cuneiforms, which is exaggerated further by the persistent adduction of the first metatarsal. In Figure 14, well developed transverse arching of the tarsus and metatarsus is evident.

The individual tarsal bones show various interesting characteristics, some of which will be mentioned. The neck of the talus is turned medially and plantarwards somewhat more than is the case when it is fully developed. The articulating surface between the head of the talus and the

FIG. 13

Embryo IV; photograph from the back of the wax-plate model of the left lower leg and foot.

FIG. 14

Embryo IV; photograph from the tibial side of the wax-plate model of the left lower leg and foot.

FIG. 15

Embryo IV; photograph from the fibular side of the wax-plate model of the left lower leg and foot.

navicular runs obliquely from dorsal and medial to plantar and lateral. The head of the talus is thus in supination.

The position of the calcaneus is strikingly different from that in the fully developed foot. If the mechanical long axis of the lower leg is established by a line connecting the center of the transverse diameter of the foot with the center of the transverse diameter of the knee—and the wax model allows the construction of such a line almost exactly—the calcaneus will be found to lie almost entirely lateral to it. Both the tuber and the corpus calcanei are obliquely placed so that the dorsal surface tilts laterally and the plantar, medially. The calcaneus does not "stand" vertically, but "lies" in a supinated position. The articular processes to the talus are well developed, and the joints themselves are completely formed.

One should observe the apportionment of the bulk of the calcaneus which is well shown in the side view of the model (Fig. 15) and especially in the section (Fig. 16). While the proximal (dorsal) half including the tuber is relatively small, and low in its vertical measurement; the distal (ventral) half,—*i.e.*, the processus anterior, is large and thick. The proportions are exactly the reverse of those in a fully developed calcaneus where the posterior part is large and the anterior short and low. Hueter has previously alluded to the remarkably large size of the processus anterior calcanei in the new-born. This disproportion may be shown even more clearly in a foetus of two and one-half months. The increased height of the anterior portion seems to prevent the head and neck of the astragalus from "digging into" the calcaneus, and suggests an anatomic reason for the persistence of equinus in the tarsus, and in part for the marked supination of the calcaneus.

The calcaneocuboid articular surface is greatly rotated so that the medial border is elevated dorsally and the lateral depressed plantarwards. The greatest diameter of the joint surface is therefore rotated into supination as is the case with the talonavicular joint.

FIG. 16

Embryo IV; photomicrograph of a sagittal section through the foot.

The cuboid, navicular, and three cuneiforms lie, not next to each other, but one over the other, so that a cross section of this part of the foot has the appearance of an inverted fish hook *f*. The point is formed by the medial protuberance of the navicular, and the first cuneiform. A decided arching of the tarsus with a plantar concavity is evident in Figure 14. The sagittal section, as shown in Figure 16, also establishes the

fact that in addition to the talus and calcaneus, the navicular and cuboid and the first and second cuneiforms lie on top of each other. It also demonstrates the extreme rotation of the skeleton of the foot into supination.

While the individual bones have been closely crowded together and formed into an arch so that the size of the tarsus has been diminished, the metatarsus is still markedly spread out; although here too, a definite transverse arching is evident (Fig. 14). The first metatarsal is markedly adducted.

From the standpoint of orthopaedics, the foot is in the third stage, and we find:

(1) a slight pes equinus,
(2) a marked pes supinatus, and
(3) a metatarsus varus.

Fourth Stage

Embryo V is fifty-seven millimeters long and at the end of the third month. The shape of the foot still greatly resembles that in Embryo IV. The feet are in the so called "prayer position" (Fig. 17). The soles are approximated, with the plane of contact corresponding to the mid-plane of the body. The foot itself, as in Embryo IV, is in slight equinus and marked supination. The first metatarsal and especially the toe are bent cranially,—that is, adducted.

FIG. 17

A front view of Embryo V, 57 mm. long.

Embryo VI, which is about two weeks older than Embryo V, is representative of a new stage. The individual bones are similar to those in the adult, as the wax model (Fig. 18) shows. The variations from the previous stage are as follows:

The talus is not much altered. The calcaneus is appreciably less supinated than in Embryo IV. The processus anterior is still long and high.

The anterior tarsus is still further decreased in its transverse measurement. The concave plantar arch is narrower, as a result of further approximation of the medial and lateral ends,—*i.e.*, the first cuneiform and the plantar projection of the cuboid. At the same time, the depth of the arch is increased. There is also a partial depression of the curve along the medial border, so that the first cuneiform is shifted plantarwards (Fig. 19).

FIG. 18

Embryo VI; photograph from the front of the wax-plate model of the left lower leg and foot.

The metatarsus shows similar changes. The bases of the bones are crowded together. The previously existent concavity of the transverse arch is narrower and deeper. On the medial border it is depressed so that the first metatarsal is displaced more toward the sole than in Embryo IV. In fact, this is the lowest point of the medial border of the foot. But this low point is still some distance from the theoretical weight-bearing surface.

FIG. 19

Embryo VI; photograph from the back of the wax-plate model of the left lower leg and foot.

The heads of the metatarsals are so situated that a line through their heads inclines cranially from lateral to medial, forming an angle of about forty-five degrees with the theoretical horizontal weight-bearing plane of the foot.

The first three metatarsals are adducted, and especially the first.

As compared with Embryo IV, in Embryo VI the metatarsus has been everted into a position of forty-five degrees less supination.

Like the metatarsus, the whole foot has turned from supination toward pronation. This rotation is the most characteristic change of the fourth stage. It continues during the remainder of foetal development and is not yet complete in the new-born.

From the orthopaedic aspect, in the fourth stage the foot is in mid-supination and slight metatarsus varus.

On the basis of his studies of the relationship of the foot to the lower leg during the various stages of embryologic development, the writer can summarize as follows:

If the plane that passes through the long axis of the lower leg and the transverse axis of the knee is called the *plane of the lower leg*, and the one transversely through the long axis of the foot-plate is called the *plane of the foot*, the following sequence occurs:

In the first and second months the planes are superimposed. Toward the end of the second month the plane of the foot rotates into supination, so that at the beginning of the third month it is at right angles to the plane of the lower leg.

Then in its own plane the foot begins to bend toward the head. The ankle joint lies at the intersection of the planes and with it as an axis the foot plate flexes cranially along its medial border. This continues until, at the middle of the third month, the long axis of the foot is perpendicular to the plane of the lower leg.

Finally the foot plate rotates toward pronation on its long axis until the planes of the foot and lower leg are in the relative positions assumed in the human adult (from the fourth month on).

This presentation is somewhat schematic, of course. The changes do *not* actually occur within the exact limits of four stages, but by means of gradual, continuous transformations.

Then what are the basic reasons for the peculiar embryonic development of the form of the foot, and for the fact that every station corresponds to a typical position of the foot?

Fick thought that the changes resulted from a simple mechancial adjustment to the size of the uterine cavity.

As opposed to Fick's purely mechanical theory of the development of the form of the foot and the lower extremity in general, a very different view had been advanced long before (1842) by Eschricht. "The embryos of all animals are known to lie in the egg as though crouching or rolled up; those of the higher vertebrates being doubled up against their abdominal walls. One who merely examined the full-term foetus might easily suppose that this were entirely the result of a lack of adequate space. But this general folding up of the body is *most extreme* in the earlier embryonic stages, when the embryo still makes up only a very small part of the entire contents of the egg. This single fact points definitely to the existence of entirely different factors. A more thorough study of the bent members themselves establishes this completely."

So Eschricht showed that the primary bending of the limbs as well as that of the head and spine is explained by *the form of the bony framework*. This fundamental fact is invariable. The curves of the bones were not altered by dividing or removing the muscles, as Eschricht proved in human embryos of two and three months. The attempt to "straighten" the bent limbs through compensatory joint movements also failed in embryos.

From his investigations, Eschricht concluded that during foetal development, the form and position of the foot and of the extremity in general result from internal and *not* external forces. He believed that every individual bone assumes by degrees a predestined form, and that collectively the bones furnish the basis for the external appearance (form and position) of the entire extremity.

Later, dominated by the Darwinian theory, Lazarus, Klaatsch, and

Weidenreich observed the likeness to the crouching and climbing primate foot in the position of the human embryonic foot. This position was attributed to the form of the component parts. The changes of form and position during the embryonic period were considered phases in the transformation of this primate foot into the characteristic human standing and running foot.

The results of the author's embryonic studies may be summarized as follows:

Bessel-Hagen, the author of the greatest monograph on club-foot, advanced the theory that during its embryonic development the foot passed through *no* stage of so called "physiologic club-foot." This belief was endorsed by other investigators and taught authoritatively by Hoffa. But it is *untenable*. On the contrary, if the deformities of the foot which have been designated collectively as "congenital club-foot" are analyzed into their three chief components,—plantar flexion, adduction, and supination—one discovers some of these in all of the stages of early embryonic development. The relationship is shown somewhat schematically in the following table:

TABLE II

Stages of physiologic embryonic development:	COMPONENT FACTORS IN PRIMARY CONGENITAL CLUB-FOOT					
	Plantarflexion		*Adduction*		*Supination*	
	Marked	Slight	Tarsus	Metatarsus	Marked	Slight
First stage (Second month)	+		+	+		
Second stage (Beginning of the third month)	+			+	+	
Third stage (Middle of the third month)		+		+	+	
Fourth stage (Beginning of the fourth month)				+		+

THE PATHOLOGIC ANATOMY OF CONGENITAL CLUB-FOOT

Before comparing the physiologic embryonic forms of the foot with the pathologic congenital club-foot, it is necessary to study the anatomy of the latter. The work must be limited to the examination of specimens in which the deformities are undoubtedly of the congenital type. The slightest

secondary change of the bones might lead to the formation of faulty conclusions. Specimens from older foetuses and new-born babies are particularly good for this purpose, but almost none of these have been written up in the literature.

Hermann v. Meyer was able to dissect the club-feet of a new-born child and a foetus of seven months. He reports the following: In both cases the navicular still articulates with the head of the astragalus, but is displaced so far medially that it either touches the medial malleolus or actually articulates with it. The cuboid lies on the medial side of the processus anterior calcaneus in both specimens. The calcaneus in both cases is rolled up and inwards and turned plantarwards to such an extreme degree that in one case the upper corner of its processus posterior touches the tibia. In the other specimen the talus is turned plantarwards along with the calcaneus to such an extent that the greatest part of its trochlea is exposed in front.

Adams, Hueter, and others have studied the pathologic anatomy of the individual bones of club-feet in the new-born. Their results were summarized by Hoffa somewhat as follows:

The body of the talus is flattened, and posteriorly it is sharpened into a wedge. Only the posterior part of the trochlea articulates with the tibia. The trochlea itself is narrower and longer than normally. The joint surface between talus and medial malleolus is reduced in size, and instead of being vertical it runs obliquely medially and plantarwards. The articulation with the lateral malleolus is displaced farther forward, toward the neck of the astragalus. The neck is definitely elongated, and more so on the lateral than on the medial side. It is twisted medially and turned plantarwards.

FIG. 20

A front view of the left, mild club-foot of a seven-months' foetus.

FIG. 21

A view from the tibial side of the left, mild club-foot of a seven-months' foetus.

FIG. 22

A front view of the right, severe club-foot of a seven-months' foetus.

FIG. 23

A posterior view of the right, severe club-foot of a seven-months' foetus.

The most noticeable change in the calcaneus of the full-term club-foot is the development of an abnormally long and high processus anterior. At the same time this process bends medially and takes part in the general adduction of the calcaneus, the long axis of which runs from posteriorly on the outside to anteriorly on the inside. This is the reverse of the situation in the normal adult. The long axis of the talus forms with that of the calcaneus an angle which opens anteriorly. In addition the whole calcaneus is displaced laterally. The talocalcaneal joint is considerably changed. The articular surface is so tilted that it looks upward and inward with its greatest diameter pointing inward and down (Hueter). The articulation with the cuboid is also altered, being completely displaced to the medial side.

The cuboid itself does not lie normally as a continuation of the long axis of the processus calcaneus, but lies on the medial side of it. The cuboid is turned inward and rotated so that its dorsal surface has come to lie underneath. It is more rectangular and its height is diminished.

The navicular lies medial to the head or even the neck of the astragalus and is vertical instead of horizontal. The bone has a wedged appearance corresponding to the decrease in thickness on the lateral and plantar sides.

The cuneiforms are rather behind than beside one another, and so situated that the posterior joint surfaces run obliquely backward instead of perpendicularly.

The author has occasion to report two additional dissections of the seldom described type above mentioned. With these the method of Hans Virchow of "Zusammensetzung nach Form" was employed.

He was fortunate in having at his disposal a seven-months' foetus with a spina bifida of the cervical vertebrae, from which he removed only the lower extremities to above the knees. On the right there was a most extreme type of club-foot (Figs. 22 and 23), and on the left a moderate degree of the same deformity (Figs. 20 and 21).

The legs and feet were preserved in formalin and then the muscles and fascia dissected away.

A very important condition was found in the *fascia*, which covered the medial (anterior) surface of the whole tibia. While this appeared normally veil-like on the left, on the *right* it was *thick and leathery*. This fibrous band ran to the middle of the medial border of the foot where it blended with the deep fascia. Miscroscopic examination of the upper third of this fascia discloses an indiscriminate intermingling of muscular tissue, elastic fibers, connective tissue, nerves, and fat (Fig. 24). The *muscles* of the right lower leg and foot are appreciably less well developed, but show no difference in structure microscopically.

Plaster molds were made for the muscle-free skeletons, and then the ligaments were also dissected away. The following conditions were found:

Right foot: Ligamentum talofibulare posterius very weak, normal situation; ligamentum talofibulare anterius very weak; ligamentum

calcaneofibulare very weak, horizontal position; ligamentum fibulo-naviculare, that usually lies *on* the ligamentum talofibulare, is just medial to it and very weak; ligamentum calcaneotibiale (going to the sustentaculum) not demonstrable; ligamentum talotibiale posterius weak. The calcaneonavicular branch of the ligamentum bifurcatum forms a socket in which the head of the talus lies. It and the calcaneocuboid branch are markedly hypertrophied.

The ligamentum talotibiale anterius lies partly between the malleolus internus. It looks like a semilunar cartilage which has been pushed in between the bones mentioned.

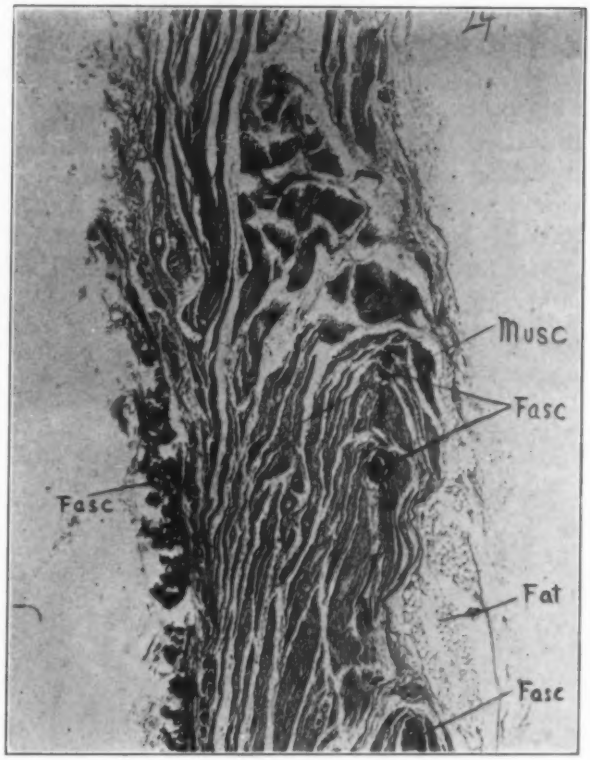

FIG. 24

A photomicrograph of the fascia from the anteriomedial side of the right tibia of the seven-months' foetus. The section is cut from the upper third. It shows an intermixture of muscle fibers, connective tissue, elastic fibers, nerves and fat.

Left foot: Ligamentum talotibiale anterius and tibio-naviculare well developed, normal position; ligamentum calcaneotibiale very short; ligamentum talotibiale posterius normal; ligamentum talofibulare anterius (frontal in adults) directed obliquely forward; ligamentum talofibulare posterius frontal (as in the adult); ligamentum bifurcatum normal in both branches; ligamentum calcaneonaviculare plantare also normal.

After the ligaments had been dissected away, the individual bones of the foot and lower leg were separated and laid in their plaster beds. Thus both the form and the relations of the bones could be studied.

Right foot: In general, the relations of the right lower leg are normal (Figs. 25 and 26). As shown by the transverse axes of the knee and ankle joints, there is a torsion of the bones of the lower leg, and the ankle joint is rotated inward about minus twenty-five degrees. The right ankle joint is smaller than the left in all dimensions, but shows no other abnormality.

The foot plate is related to the lower leg in such a way that they lie

in the same plane (the adult frontal plane). Therefore, the lower leg and foot plate could be laid flat on the table.

If one observes the lower leg, calcaneus, and talus from the fibular side as they lie clearly outlined in the plaster mold (Fig. 27), one notices that the long axis of the talus forms a direct continuation of that of the tibia (*T*—*T*). The long axis of the calcaneus is also chiefly vertical. There is a certain diagonal component which runs from posterior above to anterior below (*C*—*C*). The calcaneus is so markedly tilted into a vertical position that the posterior process is resting against the external malleolus and the posterior border of the lower end of the tibia, articulating with both of them.

The position of the talus and calcaneus in the frontal plane is also interesting. Their general direction (Fig. 28) is an oblique one (from lateral above to medial below) so that they form an angle of about forty-five degrees with the horizontal axis of the talotibial joint. The long axis of the two bones is therefore parallel.

The third change apparent in both bones is rotation. The head and neck of the talus are twisted into supination, so that the transverse

FIG. 25

A front view of the skeleton of the right foot of a seven-months' foetus, with the bones embedded in plaster.

FIG. 26

A posterior view of the skeleton of the right foot of a seven-months' foetus, with the bones embedded in plaster.

FIG. 27

A view from the fibular side of the tibia, fibula, talus, and calcaneus of a seven-months' foetus. The bones have been reassembled in the plaster bed.

FIG. 28

A front view of the preparation shown in Fig. 27.

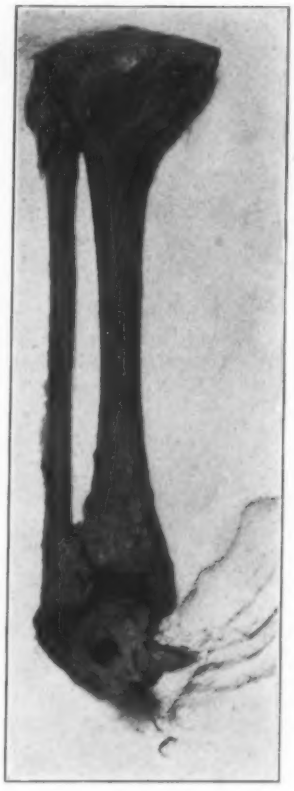

FIG. 29

The same as Fig. 28, except that the talus has been removed.

diameter of the talonavicular joint surface is oblique,—that is, high medially and low laterally. In the adult, the line is known to be either transversely horizontal or oblique in the reverse direction (medially low and laterally high). The calcaneus shows the same twisting into supination. This is evident in the rotation of the surface of the calcaneocuboid joint. Its long diameter, as in the case of the talonavicular joint, is oblique (high medially and low laterally). The corpus and tuber calcanei have rotated on their long axis into supination so that their lateral border has shifted down to the plantar side and the medial up to the dorsal. This is clearly evident in Figure 26, where one may also observe that the sustentaculum tali touches the medial malleolus. In Figure 29, the relations of the calcaneus to the tibia are shown after the removal of the talus, and the same condition is apparent.

There is a fourth important factor in the relationship of the talus to the calcaneus. If one observes the skeleton of a normal adult foot from above,—that is, from the dorsal surface—he sees only a small part of the

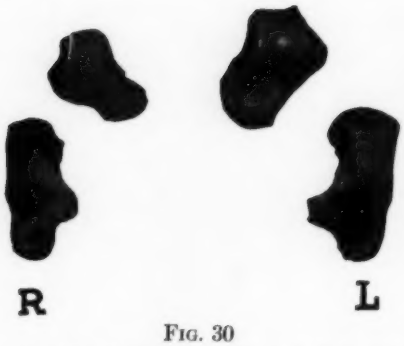

FIG. 30

A view from above of the tali and calcanei of both feet of a seven-months' foetus.

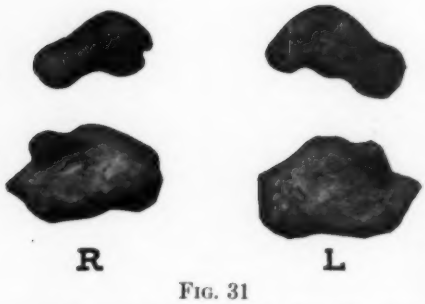

FIG. 31

A view of the bones in Fig. 30, from the medial side.

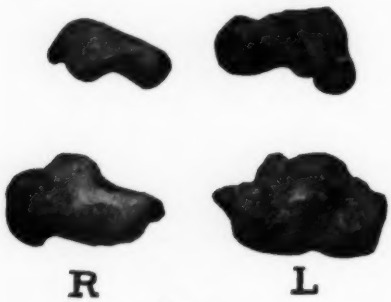

FIG. 32

A lateral view of the bones in Figs. 30 and 31.

FIG. 33

The same tali as in the preceding, seen from below.

lateral side of the corpus calcanei projecting beyond the border of the talus. In a similar view of the skeleton of a congenital club-foot, on the other hand, almost half of the calcaneus is visible. This is shown in both Figures 28 and 29. In other words, in our preparation the calcaneus lies only partly under (plantar to) the talus, a large part being *apposed to it laterally*.

The position of the *cuboid* is characteristic in that its long axis does not continue in the long axis of the calcaneus, but forms with it an angle which opens medially and plantarwards. The formation of an articulation between the two occurs, *not* on the anterior surface of the processus anterior calcanei but on its medial side.

The *navicular* lies on the medial aspect of the head and neck of the talus, and extends so high up that it forms a pseudo-joint with the internal malleolus. In reassembling the bones of the foot, it stands vertically instead of lying horizontally.

The three *cuneiforms* lie perpendicular to the long axis of the navicular. The first metatarsal is attached to the medial border of the first cuneiform and shows a remarkable degree of adduction. The other metatarsals are similarly adducted.

Therefore, through his specimens the writer can verify the findings of v. Meyer, Hueter, Adams, Kocher, and others with regard to the *changes in form of the individual bones.*

The findings in the *talus* may be listed as follows: the wedge shape of the posterior part of the corpus; the narrowness of the trochlea, and the leveling of the contours of the non-articulating part of its joint surface (Fig. 30); the diminution of size, and posterior location of the medial articular surface (Fig. 31); the elongation of the lateral articular surface and its displacement forward to the neck (Fig. 32); the slenderness of the neck (Fig. 30), and its plantar and medial deviation (Figs. 30 and 31). As seen from below (Fig. 32), the surface articulating with the calcaneus is smaller and less irregular than normal.

Examination of the *calcaneus* confirms the abnormal length of the processus anterior which equals that of the corpus and the processus posterior together. A definite increase in thickness or height is also evident (Figs. 31 and 32). The fascia articularis posterior for the talus, that normally shows the well rounded half surface of a cone, is smaller in all ways and presents only a ridge which meets the long axis of the calcaneus almost transversely (Fig. 30).

The previously described changes are present in the other bones of the tarsus (navicular, cuboid, and cuneiforms).

Left foot: The foot plate is bent up to about a right angle with the lower leg. It is in extreme supination so that the whole width of the foot

FIG. 34

A view from the tibial side of the left foot of a seven-months' foetus, with the bones embedded in plaster.

FIG. 35

A view from the fibular side of the preparation shown in Fig. 34.

plate is visible in both the medial and lateral views (Figs. 34 and 35). Torsion of the lower leg is not evident. The transverse axis of the foot and the knee joint lie in the same plane. The long axes of the talus and calcaneus do not intersect this plane perpendicularly, but at an acute angle which opens medially. The tarsus, and as a result the whole foot plate, is somewhat adducted. The remaining tarsal bones (those distal to Chopart's joint) take part in the general supination of the foot plate. The metatarsals are adducted. The medial deviation of the first metatarsal is marked, so that its base articulates with the medial border of the first cuneiform (Fig. 35).

The individual bones are morphologically little changed. They display in general the forms found in a seven-months' foetus. The increase in height and length of the processus anterior calcanei is quite apparent (Figs. 31 and 32 left).

In comparing the anatomic deformities of congenital club-foot with the physiologlc forms of the embryonic foot, the markedly deformed right foot will be used as an example of the congenital deformity:

1. Compare Figure 27 with Figures 5, 10, and 11. The plates all show an entirely analogous vertical position of the axes of the talus and calcaneus.

2. Compare Figures 28 and 29 with Figures 2, 3, 4, 6-A, and 6-B. Here the oblique position of the talus is clearly evident. As shown in all of the plates, it enters the archway of the ankle joint (malleolar mortise) like a car which turns into the arch from the side instead of entering from directly in front.

3. Compare Figure 28 with Figures 3, 6-A, and 6-B. They all illustrate the lateral apposition of the calcaneus to the talus. Figure 6-A also shows the medial apposition of the cuboid to the calcaneus which is typical in both the club-foot and the embryonic foot.

Figures 6-B and 9 are interiestng in that they show as a physiologic embryonic phenomenon, the wedging of the processus posterior tali which so often appears in club-foot. The adduction of the metatarsals and particularly of the first, may be observed in Figures 25, 26, 34, and 35 as well as in Figures 2, 3, etc.

The comparison shows that in all of the points mentioned, a severe club-foot resembles an embryonic foot at the beginning of the second month.

The analogy is not so clear, however, with regard to one point. In the plates of the embryonic foot (Figs. 2, 3, 4, etc.) there is no clear-cut apposition of the navicular to the medial edge of the talus such as exists in the severe club-foot (Fig. 25). But there is an explanation for this apparent discrepancy. The difference is apparently one of degree only. For example, in his *very young* embryo, Bardeen described the close approximation of the medial corner of the navicular to the internal malleolus (Fig. 6-B). This relation is also apparent in Schomburg's diagram (Fig. 6-A). So it is entirely possible that the medial corner of the navicular

remains attached to the medial malleolus in this primitive position, and that the growth of the head and neck of the talus forward (distally), pushes the whole navicular to the medial side. This explanation seems to fit those cases in particular in which a true joint with a normal cavity and capsule was formed primarily. In addition, the mechanism of the development of the embryonic foot favors the medial apposition of the navicular to the talus and the altered position of the bones on either side of Chopart's joint.

Let us develop this aspect. An embryonic foot is arrested in the first stage of development,—*i.e.*, the talus and calcaneus preserve somewhat the typical form and position of the fifth week. As the development of the rest of the foot proceeds, they are not able completely to bend up toward the lower leg because the foot has failed to rotate and the talus and calcaneus are wedged into the fork of the malleolus. The sustentaculum tali also impinges on the internal malleolus and prevents the normal dorsiflexion (Fig. 29). In spite of this, the foot follows its inherent tendency to develop, and in the middle of the third month tries to complete the physiologic flexion toward the head by bending along the medial border.

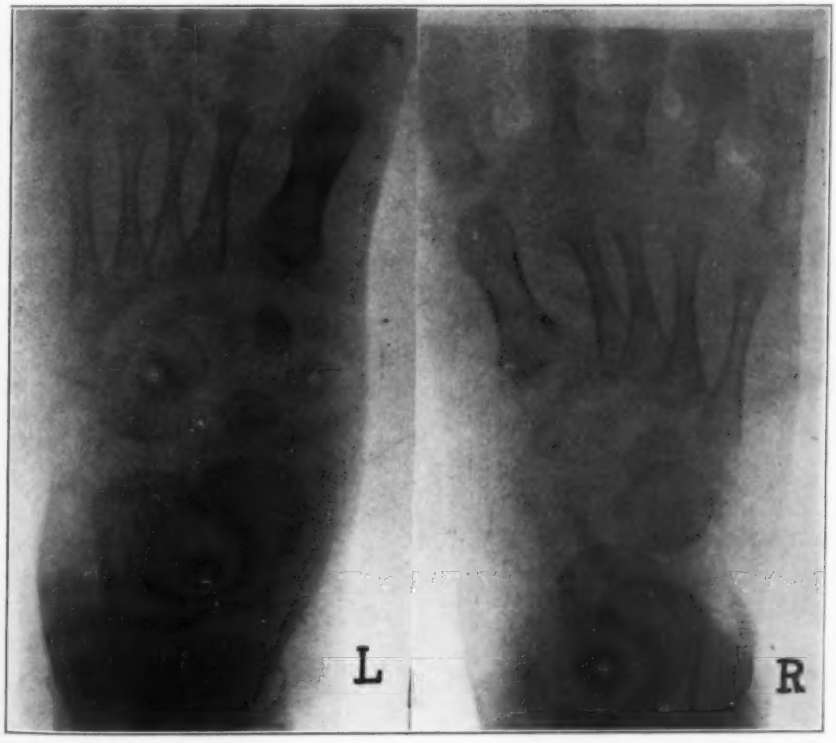

FIG. 36

The roentgenogram of the feet of a three-year-old child; left normal, right clubfoot. On the left the centers of ossification are normally developed, while on the right those of the navicular and second cuneiform are not seen.

For the above reasons, the attempt is unsuccessful so far as the ankle joint is concerned and the result is partially accomplished at the next joint,—*i.e.* Chopart's line. The navicular is turned around the head of the talus until it strikes the medial malleolus and so comes to lie beside the neck medially. Perhaps this explains the origin of the deformity in the cases in which there is no true joint between the corner of the navicular and the internal malleolus, but only close contact with connective tissue and ligamentous structures between.

One look at the left, mild club-foot (Figs. 34 and 35), is sufficient to convince one that the pathologic form of the foot is an absolute reproduction of the physiologic form at the middle of the third month.

In concluding the anatomic discussion, one more important fact must be noted. In all of the plates there is not only a deformity of the individual bones of the foot, but an *underdevelopment of all of the bones on the right side.* They are smaller in all dimensions than those on the left. In accord with this, the muscular development is much better on the left. *Bones and muscles are affected to the same extent.* The fact that the right foot is also more greatly deformed suggests a relationship between deformity and underdevelopment.

The anatomic study has therefore established two facts:

(1) The club-foot is analagous to the early physiologic embryonic form of the foot;

(2) the deformity is accompanied by underdevelopment of the bones and muscles.

As a third point one may add, in our case, the remarkable structure of the tibial fascia (Fig. 24). It exhibits a primary abnormality, a *vitium primae formationis,* for an unorganized mixture of *muscle* and connective tissue is not ordinarily found in this location.

In addition to the lack of general development demonstrated by our specimens, club-feet which have been reported in the literature have shown such abnormalities as the following:

Absence of the os navicular (Schwartz).

Absence of the first cuneiform (Christie).

Absence or hypoplasia of the first metatarsal (Christie, Kilvingston).

Hypoplasia of the second to fifth metatarsals (Young).

Absence of the front part of the calcaneus (Young).

Finally, congenital articular hypoplasia and aplasia (so called "coalition") has been observed in some or all of the tarsal joints of club-feet (Förster, Zuckerkandl, Holl, Kirmisson, Engel, and v. Meyer).

The absence and hypoplasia of the individual bones of the foot were considered by all investigators to be due to an arrest of development. Zuckerkandl attributed "coalition" to the same cause and traced it back to the failure of the primary blastomal tissue to separate.

Between the condition of full "coalition" and the other extreme of complete separation of the related parts, there are many intermediary forms. In these cases differentiation occurs, but not completely, so that

the parts are related as an epiphysis to a diaphysis. The apposed surfaces are irregular and instead of cartilage, a layer of connective tissue is found between them.

Clinically, congenital club-foot appears in its most severe form somewhat as illustrated in Figures 22 and 23, and in its mild form as in Figures 20 and 21. The numerous cases of moderate severity lie between these extremes.

Then let us consider the clinical manifestations of the congenital factors. Do they substantiate the secondary mechanical or the primary endogenous theory?

The surgeon, von Volkmann, could make out "scars of pressure" in isolated cases of congenital club-foot. From these he concluded that the deformity could be caused only by the influence of the uterine wall, the foetal membranes, or a part of the embryo itself. This conception may be well founded, but actually applies to only a very few cases.

In contradiction to it, many arguments speak overwhelmingly for the

FIG. 37

The roentgenogram of the bilateral club-feet of a six-year-old child. On both sides the centers of ossification of the naviculars and second cuneiforms are lacking, and those of the first and third cuneiforms are underdeveloped.

primary endogenous theory. The hereditary tendency of congenital club-foot is an important point. In later works (Mau and others), the fact is established that the condition is not only highly transmissible, but that it depends on definite laws of heredity.

In addition, it has been proved that the occurrence of congenital club-foot depends in a definitely regular way on sex. It is much more frequent (4 : 1) in males than in females.

It could be shown roentgenologically, as Wilhelm did in a series of congenital club-feet, that there is an aplasia or hypoplasia of the navicular and cuneiforms. In Figure 36, for instance, is shown the roentgenogram of the feet of a two-year-old child. On the normal left side the bones are well developed for the age; but on the right, where there is a congenital club-foot, the centers of ossification of the navicular and second cuneiform are lacking. In a child of six who had a bilateral club-foot (Fig. 37), the centers of ossification of the naviculars and the second cuneiforms are also not shown, while those of the other two cuneiforms are underdeveloped.

These roentgenologic findings are not unusual, but are demonstrable in the great majority of club-feet. Every experienced orthopaedic surgeon knows that these aplastic and hypoplastic conditions still remain after the complete correction of the deformity. He knows equally well how tenaciously the deformity sometimes persists, and how often the fully corrected foot tends with growth to relapse progressively into the faulty position.

All of the clinical manifestations substantiate the conclusion that congenital club-foot is not the result of a mechanical incident, but of a maldevelopment which can be traced back to more deeply lying biologic causes. We come, therefore, to the same conclusion that was reached after the embryologic-anatomic study: *The best explanation for the great majority of cases of congenital club-foot is the theory of primary endogenous disturbance of the embryo, an arrest of development.*

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MULTIPLE OSTEOCARTILAGINOUS EXOSTOSES WITH NEUROLOGICAL MANIFESTATION*

Case Report

BY JOSÉ V. SANTOS, M.D.

Department of Surgery, The University of Chicago
(Formerly Intern, Orthopaedic Surgery, Johns Hopkins Hospital)

The occurrence of an exostosis as a part of a multiple osteocartilaginous lesion in the spinal canal, giving certain neurological manifestation, is of sufficient rarity to make the report of this case of more than incidental interest. So far, from a partial review of the English literature, only a few such cases have been mentioned.

CASE REPORT

Date: March 15, 1927.

General Data: J. T., white, male, Lithuanian, single, aged thirty-nine.

Complaint: Pain and limitation of motion in the left hip. Large lump on the left leg.

Family History: Father seventy-two years old, living and well. Mother died 1916 at the age of sixty; cause of death is unknown. No congenital abnormalities or history of similar trouble in the family. No tuberculosis, insanity, cancer, heart or kidney disease.

Past History: General health excellent.

Diseases: Measles and whooping cough at age of nine; and influenza nine years ago, at which time he was confined to bed for one month.

Head and Neck: Frequent headaches occurring during winter since 1913. Occasional nose bleeding and sore throats.

Cardiorespiratory: Susceptible to bronchitis during the winter months. No hemoptysis, and no shortness of breath.

Gastro-intestinal: Appetite good. Bowels regular.

Genito-urinary: Denies all venereal diseases.

Locomotor, Nervous System, Bones and Joints: Negative except for the present illness.

Habits: Does not use tobacco or alcohol.

Weight: 147 pounds. Never weighed more than 150 pounds.

Occupation: Lumberman.

Operations and Accidents: The distal phalanges of the fore and middle fingers of the right hand were accidentally cut off about ten years ago. Wound healed without infection.

Present Illness: In 1908 a painless lump grew out on the lateral side of the left leg. Three days previously, the patient had fallen into the river and to this accident he seemed to attribute the cause of the appearance of this lump. In 1913, he had dull pain at the lower part of the back, radiating down both legs. Eight days later, swelling with slight pain of both legs was noticed. The swelling of the right leg drained pus for about nine months, and then healed. Since then, he has had a deformity of the right foot. In 1916 he began having pain in the left hip, and a year later developed a limp which became progressively worse. In 1920 the left lower extremity from the hip to the knee felt dead.

*From the Orthopaedic Department of the Johns Hopkins Hospital, Baltimore, Maryland.

He lost all motion at the hip, and in walking had to drag his left leg. About eight months later, he noticed a return of sensation and voluntary motion of the hip.

Physical Examination: General appearance is that of a well nourished man of thirty-nine, who is well developed. He is cooperative and intelligent and shows no signs of acute illness.

Glands: There are two slightly enlarged glands at the left groin.

Skin: Soft, smooth and dry. Color is normal except at both legs where slight increased pigmentation and roughening is seen.

Head: Fair size and shape. Hair has apparently normal distribution. There is no swelling and no areas of tenderness.

Eyes: Pupils large, equal, and react normally to light and accommodation. Sclerae and extra-ocular movements are normal. Ophthalmoscopic examination: negative.

Ears: No tophi and no discharge. No tenderness or swelling at the mastoid regions. Hearing is normal.

FIG. 1

Photograph showing the relative shortening of the right forearm with ulnar deviation of the right wrist. Notice also the clawing of the toes of the right foot.

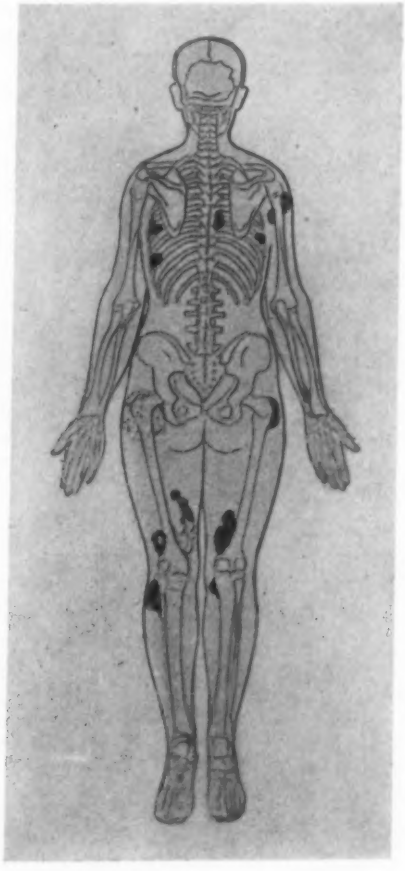

FIG. 2

Posterior view, showing the distribution of the exostoses. Note the exostosis at about the sixth and seventh thoracic vertebrae, and the big spurs at the adductor tubercles of both femora. Sixteen exostoses can be made out by palpation and roentgenogram.

Nose: No obstruction. No nasal discharge and no deviation of the septum. No tenderness over the paranasal sinuses.

Teeth: Has had a great deal of dental work.

Throat: Tonsils are small. There are some small reddish granules at the posterior pharyngeal wall.

Neck: Thyroid not enlarged. No abnormal pulsations and no asymmetry.

Thorax: Muscles are well developed. Expansion is good and symmetrical.

Heart: Not enlarged. Apex beat felt best at the fifth interspace within the nipple line. Sounds are strong, çlear and regular. No murmurs.

Lungs: Normal on percussion and auscultation.

Abdomen: No masses and no areas of tenderness; liver and spleen are not palpable.

Genitalia: Penis of normal size. Testes are felt in the scrotal sacs.

Rectal: Prostate is small and elastic in consistency.

Rectum: No prolapse of the anus. No hemorrhoids.

Gait: Simulates that of spastic paralysis. This is especially noticeable on turning around corners. There is slight limp at the left. Left leg and foot externally rotated on walking.

Upper Extremities: Right forearm is slightly shorter than the left. Right wrist shows definite ulnar deviation (Fig. 1). There are two small rounded bony masses about three centimeters in diameter felt at about the medial and lateral aspects of the upper end of the right humerus. Slight crepitation can be felt at the right wrist on rotation and flexion. All the joints show normal function. There are no deformities in the left upper extremity.

Right Lower Extremity: On inspection, there is a typical pes cavus deformity of the right foot with a marked clawing of the four small toes and a falling of the anterior arch (Fig. 4). No apparent weakness in the muscles. A small scar about the size of a quarter is seen over the middle of the anterior aspect of the right leg. The surrounding skin is slightly pigmented for an area of eight centimeters in diameter. Upon palpation an exostosis, six centimeters in diameter, is felt at about the adductor tubercle of the femur, and a smaller one, about three centimeters in diameter, adherent to the lateral aspect of the upper end of the tibia. There is no limitation of motion at the knee. The right hip has a full range of motion. Attached to the greater trochanter is an exostosis about four centimeters in diameter (Fig. 2).

FIG. 3

Anteroposterior roentgenogram of the right upper extremity. Note the broad lower end of the radius with an osteocartilaginous spur at the medial aspect of the lower third where it becomes in direct apposition to a bulbous enlargement of the ulna at this region. Note also the bowing of the radius and the shortening of the ulna.

Left Lower Extremity: Inspection shows one centimeter of apparent shortening. There is slight atrophy of the calf and thigh. The hip is held in a position of slight external rotation and slight flexion. Upon palpation a large bony mass, about eight centimeters in diameter, is felt at the upper end of the fibula. The superficial veins over this mass are markedly dilated. There are large spur-like elongated exostoses felt at the medial and lateral aspects of the lower end of the femur. These exostoses point upwards toward the hip. Motion at the knee is normal. All motions of the hip are limited. Flexion can be carried to sixty degrees; abduction to thirty-five; and adduction to twenty degrees. Extremity can not be externally rotated and only a few degrees of internal rotation is possible. A bony mass is felt about the greater trochanter. As the leg is brought into full extension from flexion, there can be felt a mass below Poupart's ligament. It seems to be attached to the lesser trochanter. Pain is elicited on pressure over the greater trochanter. There is no redness or increase in local heat about the hip.

Measurements of Lower Extremities:

Apparent shortening	1 cm. left	
Ant. Sup. Iliac Spine to Int. Mal.	.91 cm. left,	91 cm. right
Grt. Troch. to Extr. Mal.	.85 cm. left,	83 cm. right
Bryant's	7½ cm. left,	7½ cm. right
Mid-thigh	.39 cm. left,	42 cm. right

Back: There is a slight flattening of the lumbar lordosis with a slight spasm of the lumbar muscles. Slight pain is referred to the left lower back when bending to the right. No tenderness at the spine even on fist percussion. Motion normal.

Reflexes: Positive Babinski on both sides, more marked on the left. Oppenheim positive on both sides. There is a positive ankle-clonus on the left. Knee-kick is increased on both sides. Plantar responses are both unequivocally extensor. Tendon reflexes are all active and equal in the arms.

FIG. 4

Anterior view of both lower extremities. Notice the marked contracture and clawing of the four small toes of the right foot, and the pes cavus deformity. A small part of the exostosis at the upper end of the left leg can be seen also.

FIG. 5

Photograph showing posterior view of the lower extremities. Note the huge mass at the lateral aspect of the upper end of the left leg and the dilated veins.

Cranial Nerves: Function normally.

Motor System: There are no disturbances of motility in the arms. There is no paralysis of any muscle group in the legs, but there is some irregular atrophy of the left thigh and of the muscles of both calves. Coarse fibrillary and fascicular twitchings are seen in the muscles of the hips, thighs, and calf, but none above Poupart's ligament. The right foot shows high posterior arch and claw toes. Although gait is spastic, there is but slight spasticity of the legs on passive movement. The patient has had difficulty in passing urine and has had retention.

Sensory System: The patient answers clearly and seems to feel cotton, wool, pin, and heat and cold everywhere except two finger-breadths below the nipple and along the distribution of the sixth and seventh dorsal nerves and downwards, where tactile sensation is diminished. He can discriminate, however, between heat and cold at this region.

Laboratory Examination:

Blood: White blood cells, 7160; Hb. 87 per cent. (Sahli).

Wassermann negative.

Blood Chemistry—

Non-protein nitrogen	36	mg. per 100 c.c.
Sugar	97	mg. per 100 c.c.
Uric acid	3.5	mg. per 100 c.c.
Phosphorus	6.5	mg. per 100 c.c.
Calcium	10	mg. per 100 c.c.

Basal metabolism:—9. Remarks: good test.

Urine: Amber color, sp. gr. 1020, reaction acid, sugar and albumen, negative; microscopic examination shows 4 white blood cells per high power field, no casts or blood cells.

Kidney function test:

First hour	45 per cent.
Second hour	15 per cent.
Total	60 per cent.

Spinal puncture: Clear fluid, pressure 150 mm.

Microscopic two lymphocytes per c.c.

Wassermann negative; globulin—Pandy's negative.

Mastic negative.

Queckenstedt slight block.

Roentgenological Examination:

Lower extremities: There are multiple osteochondromas producing exostoses at the upper ends of the right tibia and left fibula and both femora. Huge elongated exostoses are seen arising from the lower ends of the femora. Infectious arthritis of left hip.

Upper extremities: Osteocartilaginous exostoses at upper end right humerus and lower ends right ulna and radius. Anterior bowing of lower third of right radius, and shortening of lower end of the ulna.

Thorax: Small exostoses at the right eighth rib and left seventh and ninth ribs at about the posterior axillary lines.

Spine: Dorsal shows infectious arthritis. Exostosis at the left side of the bodies of the sixth and seventh thoracic vertebrae.

Skull: Negative. Sella normal.

Summary of the History and Examination:

History: The patient is a white male of thirty-nine years, who in 1908 noticed a painless lump on the lateral side of the left leg. He had swelling and pain of both legs in 1913. The swelling of the right leg opened spontaneously and drained pus for nine months. This healed, but clawing of the toes of the right foot was noticed soon afterward. In 1916 he began having pain in the left hip and a year later developed a limp, which became progressively worse. In 1920, he lost all motion of the left hip and leg, which felt numb. There was return, however, of sensation and voluntary motion eight months later.

Examination: The important positive findings in the examination are as follows:

Gait: Similar to spastic paralysis, especially noticeable when turning around corners.

Right upper extremity: Anterior bowing and shortening of the right forearm. Exostoses at the upper end of the right humerus and lower ends of the right radius and ulna. Slight crepitus at the right wrist on rotation and flexion.

Lower extremities: Right: Pes cavus deformity of the right foot with marked clawing of the four small toes. Exostoses were felt over the greater trochanter and adductor tubercle of the femur; and on the medial aspect of the upper end of the right tibia. Left: Exostoses at the trochanters of the femur. Hip: Flexion can be carried to only sixty degrees, abduction to thirty-five degrees, and adduction to twenty degrees. No external rotation and only a few degrees of internal rotation. Slight atrophy of the calf and thigh. There are large exostoses at the upper end of the fibula, and the upper and lower ends of the femur. Left lower extremity is one centimeter shorter than the right.

Spine: Exostosis at the left side of the bodies of the sixth and seventh dorsal vertebrae.

Ribs: Exostoses at the right ninth and left seventh and eighth ribs about the posterior axillary lines.

Reflexes: Positive Babinski and Oppenheim on both sides. Exaggerated knee and ankle jerks on both sides. Well marked ankle-clonus left. Plantar responses are extensor.

Motor system: Some irregular atrophy of the left thigh and calf muscles. Coarse fibrillary and fascicular twitchings in the muscles of the hips, thighs, and calves.

FIG. 6

Lateral roentgenogram of the left knee. Notice the large exostosis at the upper end of the fibula.

FIG. 7

Anteroposterior roentgenogram of the left femur, showing a rather broad lower end with an elongated exostosis at about the adductor tubercle.

Sensory system: Slight decrease in tactile sensation two finger-breadths below the nipples at the level of the sixth and seventh dorsal and down.

Laboratory examination: Queckenstedt test showed slight block. Slight elevation of the calcium-phosphorus balance of the blood.

Roentgen-ray examination: Anterior bowing of lower end right radius and shortening of the right ulna. Sixteen exostoses were found at the following localities: left side of the bodies of the sixth and seventh dorsal vertebrae; seventh, eighth, and ninth ribs at the posterior axillary lines; upper end right humerus; lower end right radius; greater trochanter and adductor tubercle right femur; upper end right tibia; trochanters and lower end left femur; and upper end left fibula (Fig. 2).

Operation: The patient was operated on May 2, 1927. On cutting down into the left hip joint and after chiselling off from the shaft the greater trochanter with the gluteal muscles attached, a large lobulated-like exostosis covered with cartilage was found around the neck and head of the femur. An exostosis with similar appearance was also found projecting up from the lesser trochanter. These exostoses were removed. The greater trochanter was then brought down and fastened in place again with chromic catgut. The wound was closed without drainage.

A longitudinal incision was next made over the mass at the upper end of the left fibula. An exostosis eight by four by five centimeters was found at the upper end of the fibula. This was removed. The wound was closed without drainage, and the leg held in slight abduction and internal rotation by a plaster-of-Paris spica.

FIG. 8

Anteroposterior roentgenogram of the left hip. Notice the exostosis at the lesser trochanter. The exostosis about the greater trochanter can barely be outlined.

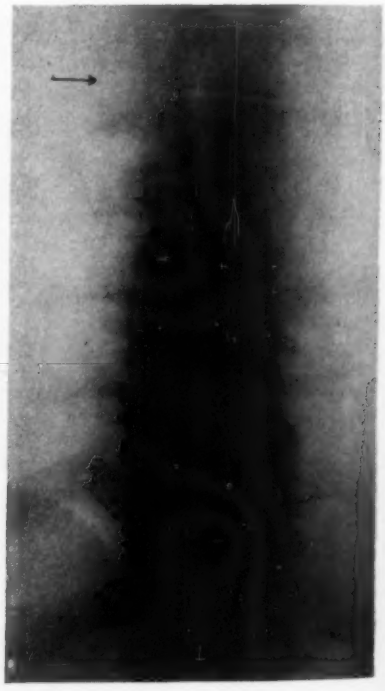

FIG. 9

Anteroposterior roentgenogram of the thoracic spine, showing slightly dense shadow at the left side of the sixth and seventh thoracic vertebrae as indicated by the arrow.

FIG. 10

Photograph of the exostosis removed from the upper end of the fibula. Note the irregularity of the surface. This is covered by thin, bluish cartilage.

Pathological Report: The specimen consists of about a pound and a half of bone. There are four pieces of bone with knob-like appearance. They are covered by cartilage. The marrow is fatty, but there are no soft areas suggesting myxoma. The microscopic sections show cortical bone, beneath which is cancellous bone and normal marrow. The outer surface is covered by a rather thick layer of cartilage (Fig. 11). The cartilage spaces contain from two to four small cartilage nuclei. There are clear areas that resemble spaces about perforating blood vessels. At the junction between the cartilage and bone the section resembles epiphyseal line, suggesting that the bone is growing. Some of the trabeculae show cartilage cap as shown in Figure 12.

Postoperative Notes: The patient made a very good postoperative recovery and the plaster was removed on May 26, 1927. The wounds healed without infection. He had a good range of passive motion of the left hip although active motion was reduced to: flexion, thirty-five degrees; adduction, thirty degrees; and abduction, forty-five degrees. The pain at the left hip was less. He then left the hospital and for a full year was treated with baking and massage of the hip. His general condition improved slowly, and the range of motion of the hip became greater. He has been relatively free from pain in the left hip until April 1928, when he started to complain of pain at the left knee and inner aspect of the left thigh, and marked stiffness of the left leg with inability to fully extend it. With this he has had some dribbling after voiding, which he does with slight difficulty.

He was again examined on May 31, 1928, when his general condition was found to be excellent, except for his neurologic condition, which is more marked than a year ago. In addition to the previous neurologic findings, the patient showed some sphincter disturbance with retardation. When tested with cotton, pin, heat, and cold, he could localize and identify the testing substances at all points of the body, but this apparently becomes difficult from the upper thoracic region downward. A region of hyperaesthesia was found at about the level of the third thoracic. Below this area, there was gradually increasing anaesthesia from about the level of the fifth thoracic down to the feet.

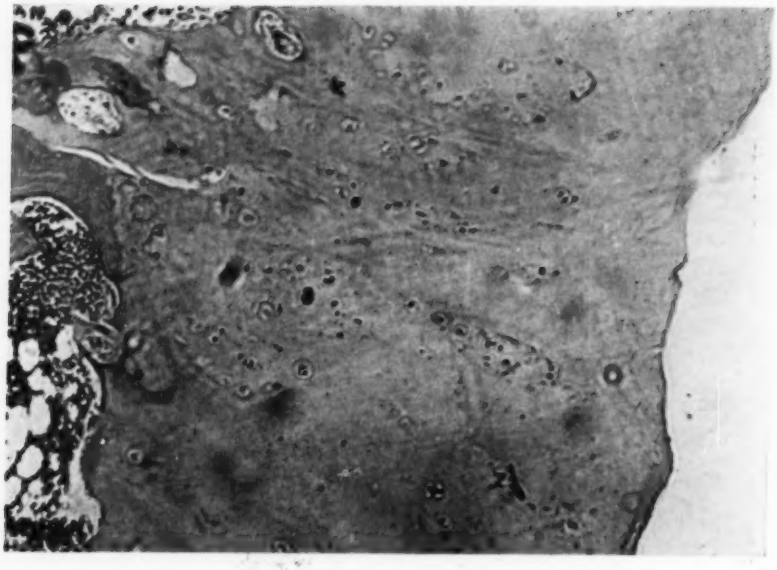

FIG. 11
Microscopic section showing thick layer of cartilage.

In view of these increasing neurologic symptoms, laminectomy, for removal of the exostosis and as a decompressive measure, was done on June 1, 1928. Two laminae above the fifth and sixth were removed. Running out from the sixth and seventh ribs and laminae and fused with them, was a mass of cancellous bone, well surrounded by a fair capsule externally, but running into the ribs and body of the vertebrae without a line of demarcation. It appears to arise from the body of the sixth vertebra. Pieces of the growth were removed with rongeurs, until the entire mass was taken out. The tumor had indented the cord but had made no erosion of the dura. The fat was absent to some extent where the major indentation was present. The wound was closed without drainage.

Ten days after the laminectomy, on June 11, 1928, the wound was perfectly dry and healed. The patient has done very well since the operation, and voids well without difficulty. The pain at the left knee and stiffness of the left leg are much less than before the operation. The area of hyperaesthesia has entirely disappeared. A radiograph of the spine taken at this time shows disappearance of the shadow previously cast by the mass. A histopathologic examination of the pieces of bone showed a picture similar to the exostoses removed at the first operation.

On careful examination, sixteen exostoses were found over the body as shown in Figure 2. It is to be observed that there is one on the left side of the bodies of the sixth and seventh thoracic vertebrae. Masses externally on the spinal column are not uncommon in multiple exostoses. However, cases of compression of the brain or cord by an exostosis within the craniospinal axis as a part of a multiple bony lesion are extremely rare. In a partial review of the English literature to date, the following are the only cases with neurologic findings recorded:

In 1907, Ochsner and Rothstein reported a case of "Multiple Exostoses Including an Exostosis within the Spinal Canal with Surgical and Neuro-

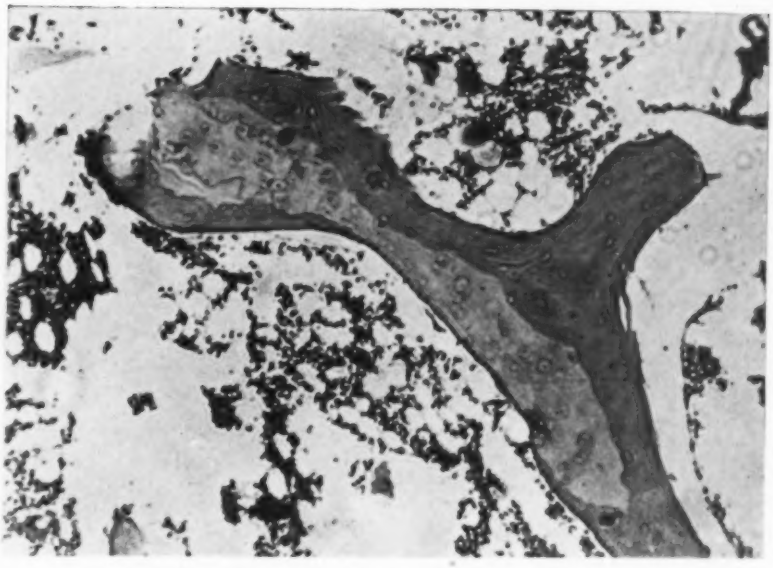

FIG. 12
Microscopic section showing cartilage cap about a spongious trabecula.

logical Observations". The patient was a male, twenty-three years of age, without known hereditary history, in whom there were 108 exostoses found. At the age of fourteen, he first noticed occasionally slight incoordination of the lower extremities. When trying to move quickly, lower extremities would tremble. This was especially noticeable in the right leg, and later appeared in the right arm. Gradually he noticed that he had less accurate control of his right arm and hand, and that the tactile sense of his left arm and hand was somewhat impaired. Later he began to complain of pain on the right side of the body on turning the head to the right. The symptoms pointed to the existence of an exostosis in the spinal canal, pressing on the cord. At operation the diagnosis was confirmed, and an intraspinal pediculated tumor, which was flattening the cord, was removed from the anterior aspect of the right lamina of the second cervical vertebra. The operation was unfortunately followed by quadriplegia with loss of bladder and bowel function, but from this condition the patient gradually recovered.

In the same year, Clark and Atwood reported a case of multiple enchondroma, one of which was growing from the sella turcica causing pressure on the pituitary body, chiasma, and crus. The patient was a male, seventeen years of age without an hereditary history. At four years of age, a tumor appeared on the sixth rib, right side, at the junction of the rib and cartilage. Later exostoses began to be felt at the left wrist, radius, tibia, and on the costal ends of all ribs of the left side. For the last two years, he had been gradually growing stiff and weak and a progressive spastic

quadriplegia developed. The spastic palsy began in the right side. The left hand and foot steadily enlarged during the last year. An eye examination showed blurring of the nasal half of the optic discs, and contraction of the field of vision on the temporal sides for form and colors.

Oberndorf, in 1910, described in some detail this same case reported by Clark and Atwood. The boy had a kyphoscoliosis with forty palpable masses. The hands and feet were increased in size and the finger tips were blunt and spadelike, suggesting acromegaly. Oberndorf considered this as due to an exostosis about the sella turcica pressing on the pituitary body. For the next three years, the patient suffered from a marked syringomyelia, and a few months later died of inanition. In this report, Oberndorf mentioned the case of Starck which presented spastic paralysis of the legs probably through pressure of an exostosis on the cord. Two small exostoses arising from the third dorsal vertebra were removed. The operation, however, was not successful in relieving the patient's condition. He also mentioned the observations of Auvray and Guillain on cases of transient hemiplegia, which the authors attributed to exostosis on the inner table of the cranium.

In 1913, Boggs reported a case of multiple congenital osteochondromas with thyroid atrophy, degeneration of the acoustic and optic nerves, and muscular atrophy. The patient was a male, aged twenty-three, who had been born with bony tumors. The father had "bony lumps" on both legs. The important positive findings were: weakness of the legs, deafness, double optic atrophy with blindness; atrophy of the shoulder girdle groups and intrinsic muscles of the hands, with wasting of the thigh and leg muscles on both sides; and atrophy of the peroneal and anterior tibial groups. Extreme talipes equinus was also noted. The thyroid gland could not be made out.

In the discussion of Percy's paper on "Multiple chondro-osteoma" read in 1914, Bevan mentioned a case of his where one of the ossifying enchondromas developed in the fourth dorsal vertebra, pressing on the cord and causing a complete paralysis below that point. M. L. Harris in the same discussion, also mentioned a case that came under his observation, in which there was pressure paralysis. It was a typical case of multiple exostoses, with a large growth about the lumbosacral junction pressing on the cord and producing paraplegia. Operation for removal of the growth did not relieve the pressure paralysis. The patient developed bed sores and large areas of gangrene and subsequently died.

Certain characteristic deformities are usually present with this condition. These had been noted by Bessel Hagen as early as 1891. The literature on multiple exostoses is so replete with descriptions of these secondary characteristics and deformities that even a short statement of what is generally observed would be superfluous. A brief mention of the common associated foot deformity in this case, however, is of significance.

Pes valgus is frequently observed in these cases. It is due to a lack of growth of the fibula with relative overgrowth of the tibia. The present

case shows clawing of the four small toes with cavus deformity of the right foot. This is a rather unusual associated feature of multiple exostoses and no similar picture has been found in the literature. Whether this can be attributed to the pressure on the cord from the spinal exostosis, or to the infection of the leg, or whether it is but an incidental finding due to a congenital anomaly in the nervous system, can not be more than suggested. Here again, the question arises as to the relation of developmental defects or anomalous conditions affecting the central nervous system with various deformities and congenital defects in other parts of the body,—as, for instance, the frequent occurrence of clubbed feet in cases of congenital spina bifida. Undoubtedly, many such deformities are associated and perhaps caused by some nervous derangements. This problem is one which merits a careful and painstaking study.

SUMMARY

1. A case of multiple osteocartilaginous exostoses is reported.
2. No known hereditary history could be obtained.
3. Sixteen exostoses were made out from palpation and roentgenograms.
4. An exostosis was found at the left side of the bodies of the sixth and seventh thoracic vertebrae. This caused cord pressure symptoms.
5. There is a marked cavus deformity of the right foot with clawing of the four small toes.
6. Three officially reported and three mentioned and recorded cases of multiple exostoses with neurologic findings were found from a partial review of the English literature.

For the permission to report this case, I am indebted to Prof. W. S. Baer, Chief of the Department of Orthopaedic Surgery, Johns Hopkins University. I also wish to thank the Department of Neurosurgery for the later care of the patient.

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THE SUPINATORY, COMPENSATORY TORSION OF THE FOREFOOT IN PES VALGUS

BY A. STEINDLER, M.D., F.A.C.S., IOWA CITY, IOWA

There are certain features in the statics and dynamics of the so called weak and flat foot which, judging from current descriptions in the textbooks, are insufficiently emphasized. Still they are important details of the pathology of the condition, and they have an immediate influence upon the details of the mechanical restoration of the normal balance.

One of these is the change in relation which exists in the pronated foot between its anterior and posterior portions, a change which is brought about by virtue of a movement of the forefoot against the back foot, or vice versa, occurring in the mid-tarsal and in Lisfranc's joint. The reasons why such a change in the normal relations of the foot necessarily must occur during certain stages of the development of the pronated or weak foot, are both static and dynamic in character.

Static Reasons. Compared with the normal equilibrium, equilibrium as it obtains in the pronated foot is shifted in the following manner: The posterior pillar of the arch is represented by the tubercle of the os calcis, which is more or less a point of contact. The anterior pillar is represented by the five metatarsal heads, presenting a considerable area of contact. The outer border of the foot touches the ground, but bears comparatively little weight in standing. Therefore, while examination of the bones of the normal foot reveals a preponderance of the weight-bearing trabeculae in the outer arch, in the pronated flat foot this is not the case.

The superincumbent weight planted in the body of the astragalus, not being met any longer by appropriate resistances in form of ligamentous and muscular structures, effects a shift in the sub-astragaloid articulation downward, forward, and inward, the head of the astragalus thereby pressing forward the relaxed calcaneoscaphoid ligament. With this shifted position the astragalar head approaches more and more the surface of support and eventually crosses the inner border of the foot print. This shift makes the sole of the foot flat and the inner border of the foot convex (*i.e.* ab-

FIG. 1

Ankle valgus. The right heel is in marked valgus whereas the forefoot is in neutral position,—*i.e.*, in supinatory relation to the back foot.

duction). The front part of the foot dorsiflexes in degree commensurate with the deformity as it progresses. These are all well known points in the statics of the flat foot, generally accepted and so recognized. The os calcis necessarily follows the pronatory lead of the astragalus, and, in looking at the foot from behind, the heel is observed in pronation. The front part of the foot, however, for a considerable length of time retains a certain freedom of motion in Lisfranc's and Chopart's articulations. The reaction which the forefoot receives from the ground is applied over an area (the five metatarsal heads) and not to a single point, as is the case in the heel. Hence, the forefoot will try to maintain contact with the floor, despite the fact that the posterior part of the foot has gone into a pronatory position, which has brought the inner aspect of the foot so much nearer to the ground than the outer.

As one examines the mobility in these joints, especially in the mid-tarsal joint, he finds that motion at this latter joint regularly occurs about three axes: a perpendicular or dorsiventral axis, a transverse or mediotarsal axis, and a longitudinal axis. All these planes of motion are involved in the development of the flat foot. The movement of the forefoot in the mid-tarsal joint about a perpendicular or dorsiventral axis, expresses itself in abduction of the foot. Movement about the mediotarsal (or mediolateral or transverse) axis expresses itself in dorsiflexion of the forefoot. Finally, motion about the longitudinal axis is expressed in the independent pronatory and supinatory motion which the forefoot executes against the back part of the foot. It is this latter motion which remains preserved, since the pressure of the superincumbent body weight prevents the forefoot from being involved in the pronatory propensity of the hind foot as produced by the forward and inward gliding of the astragalus.

As we examine these three motions which are possible in the mid-tarsal joint, we find that the abduction in this joint,—that is, the motion occurring about the perpendicular (or dorsiventral) axis, is compensatory to the inward turn of the back part of the foot, in the course of which the head of the astragalus has come to point toward the inner border of the foot. Dorsiflexion of the forefoot again, which is a motion about a transverse axis in this joint, is compensatory to the downward descent of the back foot, and especially the downward shift of the astragalus. In an analogous fashion supinatory motion of the forefoot, which is likewise due to the

FIG. 2

Shoes corrected with cleats. Inner wedge heel. Outer patch over toes.

pressure reaction from the floor, represents a position compensatory to the pronated position of the back part of the foot. In all three instances the cause of these independent motions of the forefoot against the back foot lies in the fact that the forefoot is held fast by the necessity of plane contact with the floor. It is to be lamented that supinatory compensation of the forefoot has been so little recognized, when the abduction and dorsiflexion of the forefoot, which are likewise compensatory motions arising from static causes, are so well known; especially so when we consider that a neglect or overlooking of this feature (supinatory compensation) will lead to fundamental errors in the therapeutic balancing of the foot.

Dynamic Reasons. The dynamic reasons for the development of supinatory compensation of the forefoot are to be found in the dynamics of the gait. As the foot is set to the ground the first contact occurs with the heel. Then the foot is rolled over along the outer border until the place of contact changes to the ball of the foot. We then may say that the foot, as it is being set to the ground, rocks from the heel to the ball over the outer border.

The motion in the different joints of the foot,—tibio-astragaloid articulation, subastragaloid, and the mid-tarsal articulation,—are precisely arranged to satisfy this dynamic feature. While the tibio-astragaloid articulation is a pure ginglymus joint in which strict dorsal and plantar flexion is carried out, the motions in the subastragaloid and in the mid-tarsal joints produce the peculiar slapping motion of the foot as it is being set to the ground. This is a mixed motion consisting of supination, adduction, and plantar flexion. It is with this supinatory motion that the toes normally grip the ground and this motion is preserved even after the talus, sliding forward and inward upon the inclined upper surface of the sustentaculum tali, has forced the back part of the foot into the characteristic pronation.

FIG. 3

Shoe corrections as applied. Shoe on left has anterior "heel" or bar in addition.

The supinatory position of the forefoot in relation to the posterior portion, which is caused by counter-pressure of the floor equal to the weight of the body as it is borne by the ball of the foot, has not remained unrecognized (Hohmann, Brandt), even though it has not found general ac-

ceptance in the recent text-books. As we look at the flat foot we see the os calcis pronated and the astragalus plantar flexed and medially deflected. Both of these, together with the cuboid, enter into the pronatory displacement of the back foot under the guidance and leadership of the astragalus. The shift of these three bones is likewise the summation of action (weight) from above and counter pressure (reaction) from the floor. Simultaneously, the same counter pressure from the floor, acting upon the anterior portion of the foot, presses against the toes and metatarsal heads so as to twist this portion of the foot in the opposite direction. Under this pressure the forefoot becomes further abducted, and, at the same time, appears supinated in relation to the posterior portion of the foot. Hence we can say that the torsion of the posterior foot is followed by a detorsion of the anterior. Two forces developed by the counter pressure of the floor be-

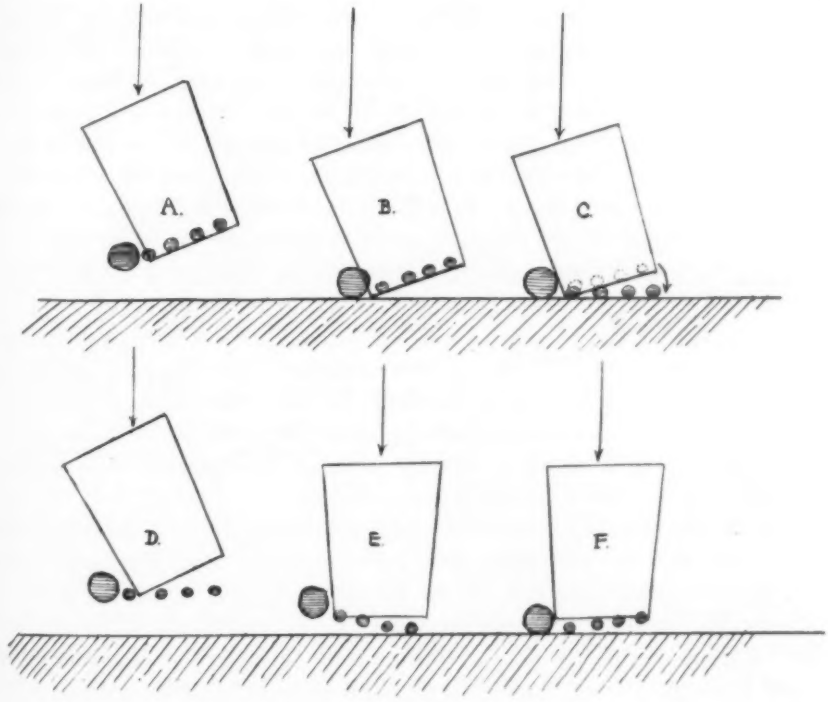

FIG. 4

A. Os calcis in valgus. Forefoot in valgus. Non-weight-bearing.

B. Foot as in *A* applied to the floor. Outer metatarsals are not bearing weight. Juvenile flat-foot type.

C. Same foot after compensatory supination has taken place. The forefoot now bears weight on all five metatarsal heads.

D. Supinated forefoot, non-weight-bearing (Compare with Figure 1).

E. Foot of *D* with os calcis brought into a vertical position by means of an inner wedge under the heel. Weight is borne on outer metatarsals onto which the foot rolls.

F. Foot of *E* with an additional wedge under outer metatarsals as in Figure 2. Entire forefoot bears weight.

come active, the posterior producing the pronatory torsion behind, and the anterior producing the supinatory counter-torsion in front.

For the rebalancing of the foot by mechanical means, these static considerations are all important. As long as the foot is supple enough to be directed and guided by contrivances,—such as plates or cleats,—in effecting correction, one must take strict cognizance of the two positions of torsion which exist between the anterior and posterior portions of the foot. An old means of obtaining correction of the pronation of the foot, as long as the latter is pliable, is to rebalance it by cleats applied to the entire inner side of the shoe, extending from toe to heel along the sole. Upon the basis of the previous consideration it can easily be seen that such a wedge at the heel, if run forward to the toes, will impart to the forefoot a further degree of supination. At the time when pronatory deformity of the back foot is corrected, this already existing supination of the forefoot will thus become greatly accentuated. As a matter of fact, we notice that such patients thereafter very readily run the shoe over at the outer side of the toes and develop there very troublesome pressure signs: callosities and bruises of the dorsal surface of the toes. This is due to the foot rolling over onto the outer side, rubbing against the upper of the shoe. Consequently, in order to cope with the mechanical situation, the correction of the pronatory deviation of the back foot should be associated with counter-correction of the supinatory torsion of the forefoot. For this purpose a separate short cleat is applied to the forepart of the shoe and nailed on the outer side so that, when pronation has been rebalanced at the back foot, and the os calcis again sits squarely upon the ground, the excess of supination which would now obtain in the forefoot has been equalized by the cleat applied on the little-toe side of the shoe.

This is the routine arrangement of pliable flat feet in all cases in which such compensatory supination of the forefoot exists; and this applies practically to all of the adolescent and adult cases.

It is only in children and in the rigid, contracted, or inflammatory flat foot that one sees the pronation deformity developed from the heel to the toes. In the latter, peroneal spasm prevents compensatory supination. In the juvenile flat foot, therefore, the cleat for correction of pronation is carried from the heel to the toes, while in the contracted and ankylotic flat foot obviously, treatment by these appliances is not adequate and the correction of the foot deformity must be obtained by other means,—as manual redressment, casts, etc.

In the great majority of ordinary cases of static flat foot, the correction of the deformity by a pronatory inner wedge under the heel, and a supinatory outer wedge under the little toe, is the treatment of choice. An anterior heel and accurately molded felt insole are often used as adjuncts.

THE RYAN ADAPTATION OF THE BALKAN-BRADFORD FRAME*

BY CLARENCE A. RYAN, M.D., C.M., NORTHVILLE, MICHIGAN

Wm. H. Maybury Sanatorium

This adaptation consists mainly of two parts: first, an adaptation of the Balkan frame, and secondly, that of the Bradford frame.

The adaptation of the Balkan frame is as follows: The frame is constructed of oak two by two inches in thickness. There are two uprights at the head and two at the foot, each pair of which is joined by a cross-bar, and these cross-bars in turn joined by a stringer. The uprights are forty-eight inches long and the cross-bar between the uprights is twenty-two inches long. The stringer connecting the cross-bars extends from the head of the bed to the foot and is approximately six feet and six inches long, depending on the length of the bed to which the frame is attached. The uprights are attached to the bed by U bolts as shown in the diagram, and the whole frame bolted together. If it is desired to put on oblique traction, a bar can be run from the stringer across the head or foot cross-bar to form any desired angle.

Since this adaptation was originally designed for use in conjunction with the modified Bradford frame, pulleys were attached to the uprights, which at the lower ends were attached to the Bradford frame, thus permitting the elevation of the Bradford frame to any angle. The pulleys used are one and one-half inch double blocks, which greatly lessen the amount of pull necessary to raise the Bradford frame with the patient upon it.

The modified Balkan frame consists of a wooden stretcher twenty-two inches wide and six feet and four inches long. In order to produce strength with lightness the sides of the frame are composed of two pieces of three-quarters by two-inch yellow pine. It is bolted at the ends and separated in the middle about one inch, so that there is a bow construction. The ends of the frame are three-quarters by four inches. To prevent sagging of the frame, a third cross-piece is set into the frame twenty-four inches from the foot. This cross-piece is the same size as the ends. From the middle of this cross-piece to the middle of the foot of the frame runs a bar three-quarters by two inches. The upper half of the frame is covered with canvas which is stretched tightly across the frame. The part of the canvas lying under the patient's buttocks is scalloped out to permit the more easy insertion of bedpan or other toilet necessities, and the canvas reenforced just above this scallop in order to better carry the patient's weight.

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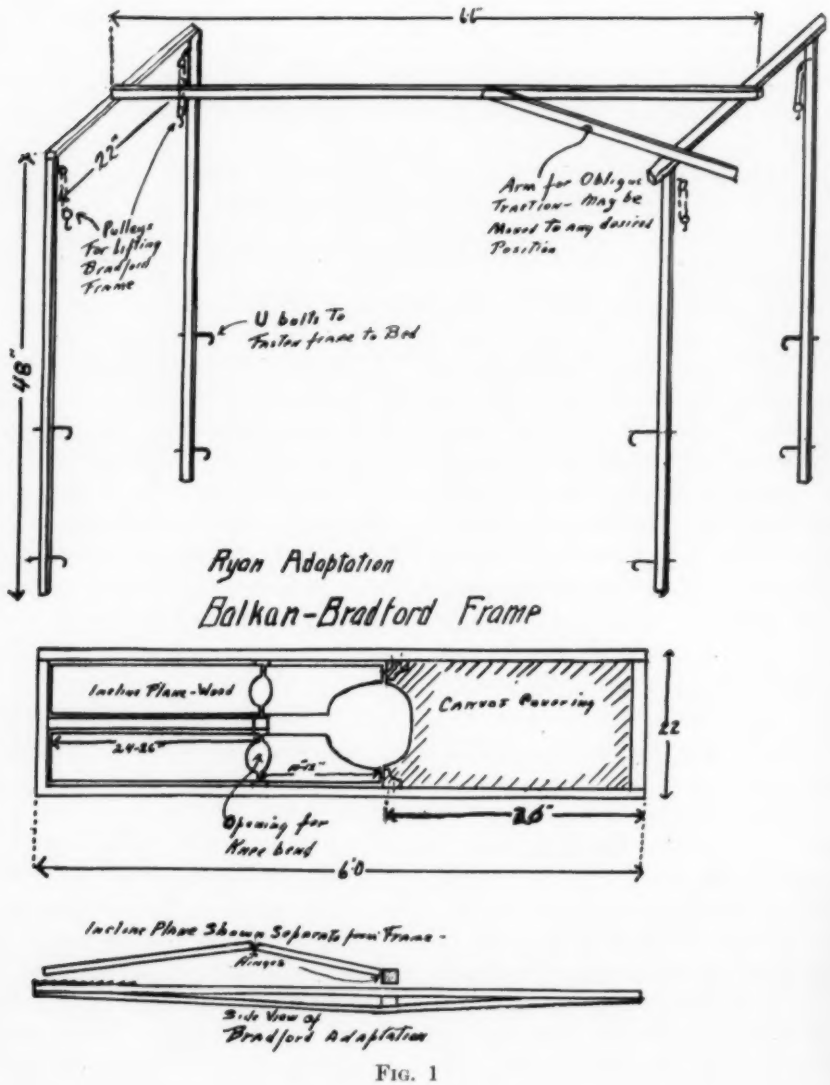

FIG. 1

The lower half of this modification consists of two incline planes (one for each lower limb). These incline planes are constructed of white pine, one-half inch thick by eight inches wide, with a hinge joint at the point where the bend of the knee comes. The length of the plane from the attachment to the outer frame to the knee joint will vary according to the length of the thigh of the patient to be treated. It will usually be found that the length of this part will be between ten and twelve inches. The lower part of the incline plane is twenty-four inches, permitting plenty of length for manipulation of the frame. As is shown in the diagram, the knee joint is hollowed out in an elliptical form in order that no pressure may come upon the under side of the knee when the incline plane is flexed at the knee. The part

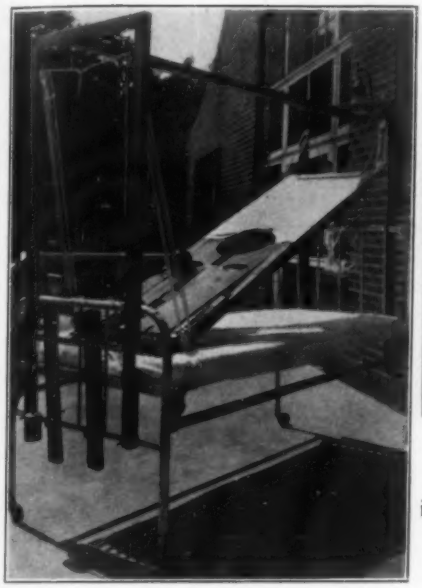

FIG. 2

Balkan-Bradford adaptation showing position of Balkan frame when attached to the bed, and method of attaching pulleys to both frames.

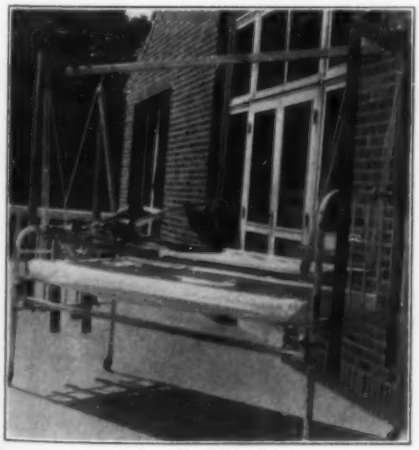

FIG. 3

Right incline plane raised to an angle of 60 degrees.

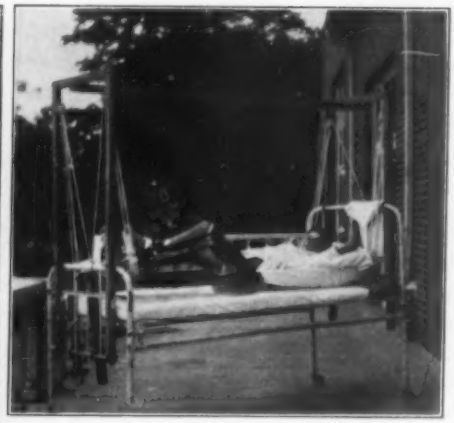

FIG. 4

Position of patient on frame, elevated 4 inches from mattress. Side view.

FIG. 5

End view, same as Fig. 4, showing attachment of weights to foot of bed.

next the buttocks is also shaped as was the canvas covering the upper half of the frame. These incline planes are attached to the outside frame by a triangular bracket fitting under the incline plane, and the incline plane attached to the brackets with hinges three inches wide. The triangular blocks are bolted to the outside frame. To the sides of the outer frame at the foot, on the upper side, are attached notched pieces of wood two inches wide by eighteen inches long into which the notches are cut every two inches. A third notched piece is fastened to the bar which runs from the center of the foot of the frame to the cross-bar twenty-four inches above the foot. To the lower end of the incline plane is attached a bar which extends one inch to either side of the incline plane, which bar fits into the notches to hold the plane at the desired angle. If it is desired to flex the hip while retaining the knee in extension, the incline plane described may be replaced with a solid piece, which is not jointed at the knee. In this case the plane is supported upon an upright fastened to the outside frame, through which an adjustable bar is passed so that the desired amount of flexion can be obtained. On the upper side of this incline plane is attached a pulley block which permits the traction rope to run freely over the end of the plane.

Traction, when desired, is maintained by the use of leather cuffs, one running around the leg above the knee and a second around the leg above the ankle, these two being joined together by a leather strap on both the inner and outer sides of the leg, which straps are adjustable for length. From the lower cuffs adjustable straps run to a footboard to which the traction ropes are fastened. In the diagram the traction ropes are shown passing over pulleys attached to the foot of the bed. These pulleys are mounted on pieces of wood two inches wide by three-quarters inch thick by eighteen inches long, which in turn are fastened to the bed in the same manner as the uprights of the Balkan frame. The pulleys used in this case are one and one-half inch flat base pulleys, thus allowing the weights to swing free of the foot of the bed. In treating Pott's disease where traction is not required and where the ordinary Bradford frame is used, the use of the modified Balkan frame will be found of great service in lifting the patient or changing the patient's position more easily.

Since the Balkan frame is attached to the bed and does not rest upon the floor, the bed and frame with the patient on it can be moved from place to place for heliotherapy or other treatments which cannot be carried out in the patient's room.

No claim is made for the originality of any of the above described apparatus. This is described because we have found the combination extremely useful in this sanatorium in the treatment of bone and joint tuberculosis.

CONGENITAL DISLOCATION OF THE KNEE*

BY BRYAN L. MCFARLAND, M.D., M.CH. ORTH., F.R.C.S.E., LIVERPOOL, ENGLAND

Congenital dislocation of the knee joint is comparatively rare, though, of course, it is unlikely that all the cases have been recorded. Drehmann who collected 127 cases is largely quoted by Steindler in Abt's Pediatrics (Philadelphia, W. B. Saunders Co., V, 419, 1924).

In the four cases reported here, the ages of the patients when first seen were twenty-one days, one year, two years, and ten years respectively; two were males and two females.

CASE 1. The first case was particularly interesting in that the prenatal history was known and the foetus was x-rayed before birth. The pregnancy had seemed abnormal, the child was delivered by abdominal section at nine months and was found to be an ectopic gestation which had gone to term. In the x-ray one leg was seen to be slightly flexed and the other hyperextended. When seen twenty-one days after delivery the right hip and right knee were dislocated and the right foot was in a severe calcaneovalgus position. There was, in addition, a curious abnormality of the lower jaw and a suspected lesion of the heart. The child died shortly after being seen by the author and no post-mortem was granted.

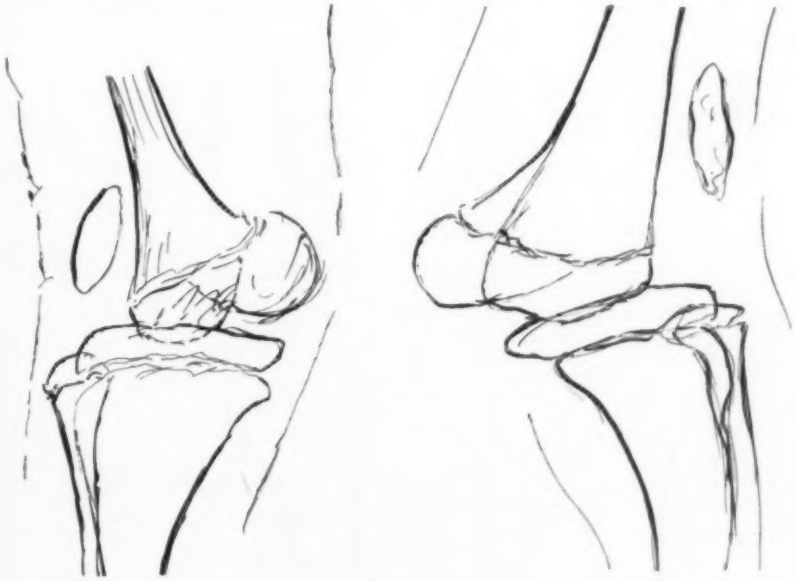

FIG. 1

Case 2, R. R., October 2, 1926. Both knees.

*Read at the Annual Meeting of the British Orthopaedic Association, Liverpool, October, 1928.

FIG. 2

Case 2, R. R., October 22, 1926. Shows improvement after preliminary operation.

CASE 2. R. R., aged ten years, had a typical deformity of the knees, aggravated by a torsion of the femora so that their popliteal surfaces faced inward and, in fact, the popliteal artery ran outside (*i.e.* behind) the external condyle. The boy's face had a peculiar flattened appearance running up to a pointed forehead; the hands, fingers,

FIG. 3

Case 2, R. R., November 18, 1926. Shows further improvement.

FIG. 4

Case 2, R. R. Diagram shows the abnormal shape of the bone ends.

elbows and feet were all abnormal in a mild degree, and the hips were both dislocated, no doubt accounting for the turning of the femoral condyles. The knees were completely unstable, could not be straightened, and he walked with great difficulty in a pair of calipers (Fig. 1).

Tenotomies of the central portions of the quadriceps tendons were done and a little improvement obtained (Fig. 2). A month later both knee joints were opened at a twenty-eight days' interval and the structures on the antero-external aspect divided transversely. No immediate improvement was obtained, but by subsequent mouldings the knees were fixed in very slight flexion (Fig. 3). The main obstacle in the way of reduction was the alteration in the shape of the bone ends (Fig. 4). The external rotation of the femora rendered retention extremely difficult.

When seen eighteen months after the last manipulation, the boy could walk with a pair of light back-splints and could stand without any support; he could flex his knees twenty degrees and they could not be hyperextended.

Case 3. I. M. This child was aged two years when first seen by the writer. An operation had been done at the age of one year, and it was possible to obtain an x-ray which had been taken before this operation (Fig. 5). It appears that one knee only had been operated on, and an attempt made to lever the hamstrings behind the femur. At any rate, when seen at two years of age, the child had the typical signs of completely dislocated knees, as well as a cleft palate, deformed index fingers, dislocated hips, and abnormal cardiac murmurs.

At the age of two years and three months the *right knee* joint was opened from the front and the tissues widely retracted. The quadriceps and iliotibial band were very tight; the central portion of the former and all the latter were divided and the head of the tibia levered behind the femoral condyles. The gap in the quadriceps was closed with fascia. A month later the *left knee* joint was opened by an antero-internal incision. The quadriceps was found to be very tight and so was detached from the patella, the hamstrings were pushed behind the femur, and the tibial articular surfaces pushed round the lower end of the femur until they rested against the posterior aspect of the articular surface of the condyles. There was no sign of a ligamentum mucosum nor ligamenta alaria; the crucial ligaments were extremely slack and attenuated. The lateral ligaments were seen to be so long and thin that they sagged into the joint space. This laxity of the lateral ligaments subsequently gave rise to considerable trouble; in fact, the tendency to knock-knee still necessitates irons in this case. There was no recurrence of the dislocation. In November, 1926 (six months after operation), the child could stand, but knock-knee irons were necessary

Fig. 5

Case 3, I. M., aged fourteen months, 1924. Shows the bilateral dislocation of the knee joints and dislocation of the hips.

FIG. 6

Case 3, I. M., aged four years, 1928.

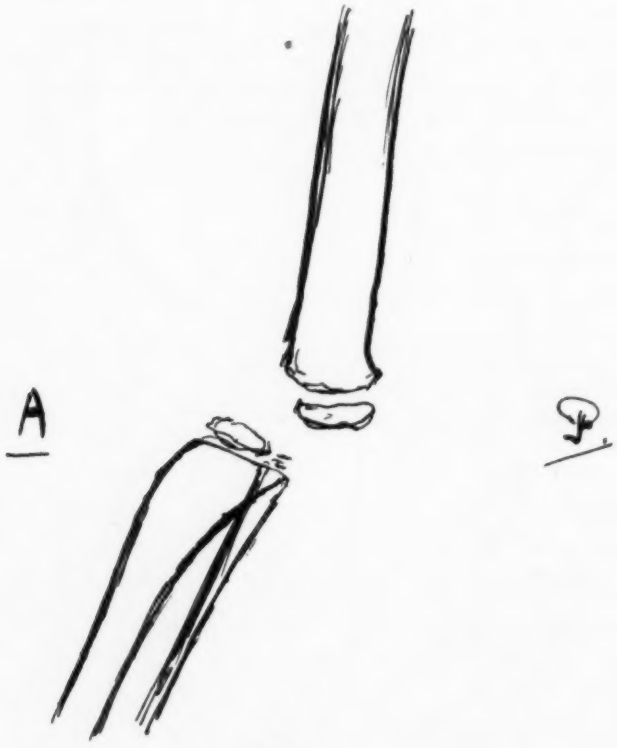

FIG. 7

Case 4, J. R., January, 1927. Shows the congenital dislocation of the knee joint.

FIG. 8

Case 4, J. R., September, 1928. Shows the result after operation.

for walking. She could flex the knees to 70 degrees and extend to 160 and 170 degrees.

CASE 4. This child was seen at the age of thirteen months, and was normal except for bilateral dislocation of the knees. The only movement possible at these joints was in hyperextension. The shins could almost be made to touch the front of the thighs (Fig. 7).

The central portion of the quadriceps tendon and the iliotibial band were lengthened by subcutaneous tenotomies on each leg. The right leg was done first and the left fourteen days later. Each dislocation was reduced with a click and maintained by the simple method of a strap round the ankle tied to one round the waist with the hip hyperextended. Two months later the child could walk without support, could extend to 175 degrees, and flex 75 degrees right and left. Thirteen months later the knees have not relapsed (Fig. 8).

COMMENTS

One or two points arise from the observation of these cases. The condition has been attributed to (1) antenatal injury; (2) wrong pull of muscles; (3) malposition in utero; (4) primary embryonic defect.

The only theories worth considering are the two last,—malposition and primary defect. Both causes may operate; and the cases fall into two very distinct groups according to their etiology. Those associated with other abnormalities, such as cleft palate, harelip, cardiac lesions, and spina bifida, are due to a primary embryonic defect. Such cases are not amenable to conservative treatment, and an open operation to secure a mobile knee is advisable.

The second group includes the cases in which the condition is unaccompanied by other serious defects; these are due to malposition in utero and respond to manipulation, aided perhaps by subcutaneous tenotomy. This idea is borne out by such cases as the author has found in the records; and lately by Griswold who in 1927 described a case, unilateral, uncomplicated, and reduced by manipulation without anaesthesia; by Wentworth who three months ago described a case, normal except for an Erb's palsy, and the knees, in which a good result was obtained by flexion and traction.

The first three of my cases fall into the first group, the fourth into the second.

In the cases of long standing a difficult problem has to be attacked. It would seem likely that a tenotomy of the anterior structures of the knee, and an osteotomy of the femur, and flexion at the osteotomy might give a useful knee.

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FRACTURE OF THE ATLAS VERTEBRA; REPORT OF THREE CASES, ONE WITH REMOVAL OF POSTERIOR ARCH FOR NEURALGIA

BY GOLDER L. MCWHORTER M.D., PH.D., CHICAGO

Assistant Clinical Professor of Surgery,
Rush Medical College of the University of Chicago

Fracture of the atlas vertebra is an unusual injury, and is quite frequently a fatal one. The first case is of unusual interest because complete disability, which was due to a bilateral neuralgia of the minor occipital nerves, was relieved by removal of the posterior arch.

CASE 1. Patient, S. H., male, aged forty-two years.

Diagnosis. Bilateral fracture of the posterior arch of the atlas with non-union, and neuralgia of both minor occipital nerves.

Chief Complaints. Severe neuralgic pains on both sides, extending upward from the neck, over the sides and the temporal region of the head, and also extending forward to the angle of the jaw. Inability to turn the head, due to pain, with complete disability.

The patient fell down a flight of stairs three months ago and struck on his head and shoulders. He was taken to a local hospital and a plaster-of-Paris cast was applied, including the trunk and head. He remained there five weeks. During this time he had soreness at the base of the skull and more or less continuous headache. The cast was removed at the end of six weeks, when sharp shooting pains started on both sides of his head. At times the pains would be more severe, but they were constantly present on the left side. Many times they were so severe that he has bitten his pipe-stem in two pieces.

Past History. The patient was a bricklayer by trade. He had been a heavy drinker for years. Father, mother, three sisters, and two brothers were living and well. There was no history of lues or tuberculosis.

Examination. The patient was a large, well built and well nourished man. He moved about with extreme difficulty, because any change in position aggravated the pains which extended from his neck up both sides of his head and slightly forward to the angle of the jaws. He was unable to turn or bend the head, especially to the left.

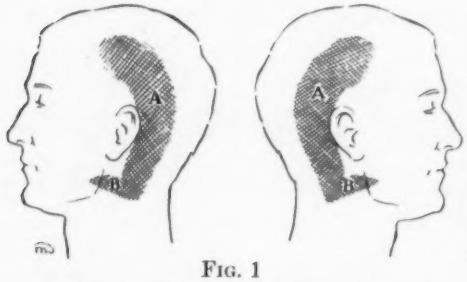

FIG. 1

In Case 1, pains were bilateral, involving chiefly the region of the minor occipital nerves, evidently due to pressure on the anterior branch of the second cervical nerve.

There was a hyperaesthesia over the sides of the head in the region of the pains. These areas began at the sides of the neck just below the base of the skull and about two finger-widths from the midline, and extended upward above the ear, and two-thirds of the distance to the top of the head (Fig. 1). They did not involve the ear. The strip of hyperaesthesia that extended forward from the neck reached the angle of the mandible. There was so much spasm of the muscles of the neck that it was impossible to determine any disturbance of motor function. Physi-

cal examination was otherwise negative. There was no difficulty in swallowing or talking.

Roentgenological Examination. Lateral views showed a fracture on each side, near the base, of the posterior arch of the atlas (Fig. 2). There was some downward displacement of the fractured lamina evident on the left side. The right side showed no apparent displacement, but there was no callus formation or evidence of bony union on either side. It was evident that the non-united posterior arch was producing pressure upon the second and possibly also upon the first cervical nerves.

Operation, July 27, 1927. Local anaesthesia. A midline incision was made. The cervical muscles were retracted and the upper cervical vertebrae exposed. The posterior arch of the atlas was found to be very movable, due to non-union on both sides. The lamina on the left side was cut across the base anteriorly to the fracture, because there was more pain and the stump was longer on this side. The posterior fragment was separated on the right side through the fibrous tissue. The vertebral arteries were seen pulsating on both sides. There was some annoying oozing at these points but it was controlled by hot packs and by compression of a muscle flap. The muscles and fascia of the neck were sutured tightly together in the midline without drainage. No cast or immobilization of any sort was used in the post-operative treatment.

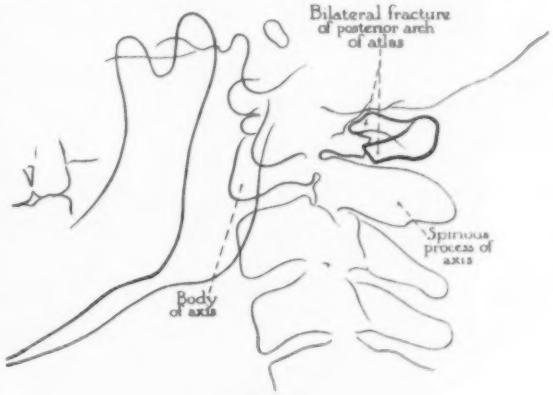

FIG. 2

Drawn from roentgenogram of Case 1, with non-united fracture on both sides of the posterior arch of the atlas.

Examination of the Removed Bone Fragments. The bone removed included nearly all of the posterior arch. The fracture line on the left side was nearer the midline than on the right side and passed near the posterior part of the sulcus for the vertebral artery. The stump of the lamina was removed with the fibrous union on the left side. There was considerable motion possible at this fracture line. On the right side, the cut extended through the fibrous area of the fracture line. There was no evidence of new bone formation or callus.

Immediately following operation, there was relief from the severe neuralgic pains. The soreness and stiffness in the neck due to the operation gradually disappeared, with occasionally a slight, dull aching sensation on the sides of the head. The patient started to work about six weeks after the operation.

Examination Three Months after Operation. The patient had been able to work without pain. His head was gradually getting more freely movable. Rotation to the left was about two-thirds of normal, and to the right three-fourths of normal. Backward extension of the head was normal and flexion of the head was almost normal.

CASE 2. C. C., male, aged forty-seven years.

Diagnosis. Fracture of the anterior and posterior arches of the atlas vertebra with lateral displacement of the right side and fracture of the odontoid process of the axis vertebra.

Chief Complaint. The patient fell from a haymow on April 18, 1928, one week previously and struck on the top of his head. He was not unconscious at any time. Following the injury, he had constant pain high up in the back of his neck with complete disability. The pain was severe and kept him awake. The most severe pain was in the

FIG. 3

Roentgenogram of Case 2. Fractures of both arches (*a*, *b*) with lateral displacement of the right side of the atlas (*c*) and fracture through the base (*d*), with tilting of the odontoid process of the axis.

midline in the suboccipital region but there was some pain at the sides of his head. These pains did not radiate upward. Otherwise his history was negative.

Physical Examination. The head was tilted slightly to the right side and slightly flexed. There was inability to rotate it, due to pain. There was marked tenderness and pain with muscle spasm over the back of the neck on palpation. The head was fixed apparently by muscle spasm. There was no evidence of cerebral or spinal injury. The cranial nerves were apparently normal. The constant pain and ache about the occipital region were increased by any slight movement.

Roentgenological Examination. A view (Fig. 3) through the wide open mouth showed a fracture line at the base of the odontoid process of the axis, with a definite tilting and displacement to the right. There was an irregular fracture line through the anterior arch of the atlas on the right side with the lateral mass displaced to the right and tilted downward. On the left side there was an oblique fracture line extending through the arch near the lateral mass but with little displacement.

Due to the lateral displacement of the right lateral mass of the atlas, it was evident that both anterior and posterior arches were broken. On the lateral view there was an increased angle between the posterior arch of the atlas and the spinous process of the axis, but with no evidence of forward dislocation of the atlas.

The roentgenological diagnosis was, a fracture of both anterior and posterior arches of the atlas, a slight lateral and downward displacement of the right lateral mass, with

broadening of the bony ring and a fracture through the base of the odontoid process of the axis with some tilting to the right.

It seemed advisable to immobilize the head by means of a plaster cast. The patient was suspended and a cast applied high up about the head and extending down to the crests of the iliac bones. The pains in the neck gradually disappeared. The cast was removed at the end of three months. Examination was made three weeks later. Flexion, extension, and rotation of the head were about one-half normal. There was little lateral bending, which was more limited on the right. There was little complaint of pain and the patient felt able to go to work.

CASE 3. F. Y., male, aged twenty-nine years.

Diagnosis. Fracture of the skull. Bilateral fracture of the posterior arch and right transverse process of the atlas vertebra. Fracture of the right transverse process of the sixth cervical vertebra. Fracture of the tenth, eleventh, and twelfth ribs on the left side. Fracture of the right clavicle. Erysipelas of the face.

The patient entered the hospital December 1, 1928. He had been struck by an automobile. There was nothing of interest in his past history.

Physical Examination. A well developed male who was conscious but who appeared to be in shock. There were multiple abrasions and cuts over the face and bleeding from the right ear. He was unable to hear on that side. There was no evidence of paralysis of any of the cerebrospinal nerves.

On attempting to flex the head, there was rigidity of the neck and the patient complained of pain. Rotation was painful and considerably limited by muscle spasm. There was tenderness over the upper cervical and the region of the right transverse process of the sixth cervical vertebra.

Roentgenographic Examination. There was a fissured fracture extending through the right temporal bone, a bilateral fracture of the posterior arch of the atlas (similar to Case 1), also a fracture of the right transverse process of the atlas, a fracture of the right transverse process of the sixth cervical vertebra, fractures of the left tenth, eleventh, and twelfth ribs, and of the right clavicle.

After the second day, the patient complained frequently of neuralgic pains starting near the occiput and extending upward to the top of the head. This area extended to the ears and was equal on both sides. His condition was very satisfactory until the fifth day, when erysipelas developed over the right ear. This spread over the entire face, neck, a large part of the chest, and one arm. There was an increasing toxaemia from the erysipelas until death, seventeen days after the accident.

Jefferson[1], in 1920, collected all reported cases of fractures of the atlas and added four more, a total of forty-six. Twenty-one of these were isolated fractures of the atlas and twenty-five were complicated with fractures of other vertebrae.

In the cases of isolated fractures of the atlas, forty-seven per cent. died, two being killed outright, three dying from remote causes. All of the patients, eleven in number, who recovered, apparently did well; one case with a cord injury also recovered. Three of these had anaesthesia of the great occipital nerves on the same side as a unilateral fracture of the posterior arch of the atlas. There was severe neuralgia of the great occipital nerve on the same side as the fracture of the arch in one case, and with a fracture of the lateral mass of the atlas in another.

In the twenty-five cases involving fractures of other vertebrae, sixty per cent. died, two being killed outright. Ten of these died from cord injury. Only ten patients recovered. Signs of a cord injury were present in three of these cases and of severe cerebral contusion in one.

In all forty-six cases, there were sixteen deaths from cord injury

which was more common in the complicated fractures. Signs of a cord injury were absent in nineteen fractures,—eleven isolated, and eight complicated. This shows that fracture of the atlas alone does not produce the cord laceration so readily as does a complicated or multiple fracture including some other vertebra. The vertebral artery was compressed in one case and torn in another. Injuries above the fourth cervical frequently kill by paralysis of the phrenic nerves.

Etiology. The common cause of atlas fracture, Jefferson found, was a fall upon the head. The mechanism, probably, was usually a tension on the atlas ring due to spreading of the lateral masses, owing to the divergence of the lines of force passing through the bone. Two other possible mechanisms have been suggested but neither, Jefferson concluded, fits in with the recorded history of the accidents. With the head in full extension, one mechanism may fracture the posterior arch by a crush between the occiput and the neural arch of the axis, and the other fracture the anterior arch by impaction of the odontoid process.

Jefferson stated that the outstanding symptoms were usually rigidity of the neck muscles and limitation of movement. Rotation was especially limited where the fracture involved the articular facets and in fracture of the anterior arch due to the articulation with the odontoid. This inability to rotate the head was considered to be quite characteristic of odontoid fracture. The movement chiefly impaired in the isolated atlas fractures was nodding. In some cases there was a protuberance felt in the pharynx. There was commonly great tenderness laterally and posteriorly. There was occasionally dysphagia and thick speech.

George[2] has described an improved position for accurate roentgenological study of injuries of the atlas and axis. The patient should lie with the mouth open and the face up in the anteroposterior view and with the face up in the lateral. He observed a congenital anomaly which may transform the groove for the vertebral artery into a complete or partial foramen. He observed that the foramen of the atlas was larger than that of the axis, which might account for the fewer cord injuries in atlas fractures.

The first two cervical nerves pass out adjacent to the atlas; one over, and the other under the posterior arch.

Spalteholz[3] described the spinal ganglion of the first cervical nerve as very small, it and the posterior root being often absent. This nerve lies in the sulcus of the vertebral artery on the atlas. In the first two cervical nerves, the posterior branches are larger than the anterior.

The posterior branch of the first cervical becomes the suboccipital nerve and is purely motor. It anastomoses with the second cervical, and paralysis might easily be overlooked. The posterior branch of the second cervical nerve is the largest of all, and is both motor and sensory. The main portion is sensory and forms the great occipital nerve. This is the nerve which Jefferson found was usually involved in atlas fractures.

Each anterior branch of the cervical first to fourth nerves anastomoses to form a plexus, which is divisible into sensory and motor branches. This plexus also sends branches to the sympathetic system. The sensory

branches largely from second and third cervical form the minor occipital nerve which supplies the skin of the lateral occipital and temporal regions of the head. It anastomoses with the great auricular, the great occipital and with the cutaneous colli, which latter arises chiefly from third cervical and at times from second cervical. This cutaneous colli supplies the skin as far forward as the margin of the lower jaw. The anterior branch of the great auricular supplies the region of the angle of the mandible, which was involved in Case 1, probably by an anastomosis with the minor occipital nerve. The anterior sensory branches of the second cervical nerve were apparently the only ones involved, since no paralysis could be demonstrated and relief was obtained by removing the posterior arch of the atlas. The pains were located chiefly in the region supplied by the minor occipital nerve; that is, the lateral occipital and temporal regions. The pain in the neck about the angle of the jaw may be explained by an anastomosis of the second cervical with the great auricular or possibly with the cutaneous colli nerves. The minor occipital nerve was not involved in any of the cases reviewed by Jefferson. The motor fibers from the anterior branches of the first and second cervical supply a few small muscles in their vicinity. The second sends a branch to the ansa hypoglossi and there are other branches to the hypoglossal from the cervical plexus.

Treatment. As a general rule, Jefferson found that treatment of a fractured atlas was limited to immobilization of the head in a plaster cast. Unless the articular surfaces were involved, he concluded that the functional results were good. In treating upper vertebral fractures, Scudder[4] advised absolute immobilization of the head for three to four months. When seen early, E. I. Berkheiser[5] has advised temporary traction on the head to relieve muscle spasm and perhaps to correct some deformity. After a few days a cast is applied.

Jefferson stated that only two cases had been operated upon and both patients died. These had complicated fractures of other vertebrae and a laminectomy was done for relief of pressure. One had a total paralysis below the level of the larynx and for a time was kept alive by artificial respiration. In the other, all four limbs became spastic two months after the accident. In another case, it was found at necropsy that a laminectomy might have led to recovery, since a small piece of bone was found pressing against the medulla and there had been gradually increasing paralysis, and death.

Relief from severe bilateral cervical nerve root pains, in Case 1, was obtained by operative removal of the posterior arch.

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PNEUMOCOCCUS SPONDYLITIS

BY HENRY MILCH, M.D., F.A.C.S., AND PAUL W. LAPIDUS, M.D., NEW YORK CITY

It is a matter of some interest that, in spite of the rather high incidence of pneumococcal infection in general, a relatively insignificant number of cases have been recorded in which the articular structures have been involved. While some authors claim a much higher incidence, the majority of students of large series of pneumonias are of the opinion that arthritis is seen as a complication in from one-tenth to seven-tenths per cent. of the cases. In most instances, the larger joints—knee, shoulder, wrist,—have been affected, but involvement of practically all of the joints of both extremities has been reported. Strangely enough, in view of the septicaemic nature of pneumococcic infections, vertebral lesions have been singularly uncommon. Even by those to whom disease of the spine is a matter of daily routine, pneumococcic spondylitis must be considered as a great rarity. In the extensive files of the Hospital for Joint Diseases and of the Hospital for the Ruptured and Crippled in the City of New York, the case reported below is the only one which we have been able to find. Several authors, Tubby and others among them, have been said to have reported similar cases, but these cases are extremely few and are very inconclusive because of the lack of definite bacteriological proof of the presence of pneumococci. Thus in the case presented by Campbell[1], which most closely resembles that observed by us, the bacteriological data are lacking and the etiology of the condition was presumptively determined by the fact that the spinal affection followed a pneumonia.

Though this chronological sequence must certainly be considered as suggestive, the validity of the presumption can by no means be accepted as established. While it is true that the vast majority of pneumococcic arthritides have been preceded by a lobar pneumonia, it is equally true that many cases of definitely proven tuberculosis of the spine have been known to follow an earlier pulmonary infection. Similarly in the case herewith presented, though the question of its pneumococcic origin can be accepted as beyond doubt, the interest lay not only in establishing the unusual nature of the infection, but also in evaluating as far as possible the contributory significance of a definite luetic and a problematical tuberculous complication.

William B., aged fifty-two, was admitted to the orthopaedic wards* of the Hospital for Joint Diseases, February 20, 1925, complaining of stiffness in both hips and pains in the back. Beyond the fact that he had suffered from a chancre some twenty-five years before, the history elicited nothing of importance up to the onset of a lobar pneumonia in April, 1924. During the convalescence from this disease, while in a city hospital,

*Service of Dr. H. Finkelstein.

the patient began to complain of a slight pain in the back and a stiffness in the left hip. About five months later, a similar disability was noticed in the right hip and the patient became unable to walk. The usual physiotherapeutic measures were undertaken and persisted in for a long time without any apparent amelioration either of the disability or of the pains of which he complained. About one week before his admission into our hospital, the patient noticed the development of a gradually increasing, slightly painful swelling over the lower left side of his back.

When seen after admission, the patient was obviously chronically ill, anaemic and moderately emaciated. The pulse and respiration were normal but the temperature varied between 98 degrees F. in the morning and 100 degrees F. in the afternoon with occasional elevations to 101 degrees F. The teeth were in very poor condition and the gums were moderately pyorrhoeic. The lungs were emphysematous. There was a faint systolic murmur over the cardiac apex. The abdomen was somewhat distended and slightly tender on the right side at the level of the umbilicus. The patient was unable to walk and, when in the upright position, stood with his hips flexed and his hands propped against the thighs. The whole spine was completely rigid. The lumbar lordosis was markedly increased. Over the spinous processes of the third and fourth lumbar vertebrae, there was marked tenderness to percussion. In this same region, slightly to the left of the mid-line, there was a slightly tender, fluctuating, hemispherical mass about the size of an orange, covered by a tense, glistening, reddish skin. Both hip joints were in slight abduction and about forty-five degrees of flexion contracture. There was marked limitation of internal and external rotation at the hip joints. The knees were in moderate flexion contracture. The knee jerks were bilaterally increased. The left ankle jerk was livelier than the right which was normal. Beyond these, no other signs of central nervous system involvement, either sensory or motor, were found.

The blood and urine examinations were relatively normal. The Wassermann test was two plus. The Von Pirquet reaction was negative. X-ray examination of the spine showed "evidence of an old hypertrophic osteo-arthritis. Bony ankylosis with calcification of the lateral ligaments is present between the second and third lumbar vertebrae. Between the third and fourth vertebrae this calcification extends completely around the joint. There is distinct evidence of rarefaction posteriorly in the adjacent portions of the third and fourth lumbar vertebrae. Changes of the same character but of lesser degree are present in the lower lumbar articulations. There is incomplete absorption of the right transverse process of the third lumbar vertebra, and almost complete absorption of both transverse processes of the fourth vertebra. The appearance is indicative of a chronic osteomyelitis of the third and fourth lumbar vertebrae with old paravertebral exudates and calcification of the distended capsule." (Figs. 1 and 2.)

A tentative clinical diagnosis of Pott's disease of the spine with abscess formation was made and, on February 26, the abscess was aspirated through healthy tissue with a long needle. About thirty cubic centimeters of a thick, greenish, odorless pus was evacuated and sent to the laboratory. On smear, many pus cells and a gram positive diplococcus but no tubercle bacilli were seen. When cultured, a pure growth of pneumococcus which agglutinated with Type 2 serum was recovered.

Because of the severe pain of which the patient complained, a plaster bed was applied with moderate relief of pain and spasm in the vertebral muscles. To overcome the flexion contracture of the hips and knees, traction (ten pounds) was applied to each leg. On March 4, a second aspiration of the abscess was undertaken and again about thirty-five cubic centimeters of pus of the same character as previously was obtained. The abscess cavity was thereupon irrigated with thirty cubic centimeters of a one-tenth per cent. solution of optochin hydrochlorid. Ten cubic centimeters of a one per cent. solution of optochin hydrochlorid were then injected and left in situ. This procedure which appeared to afford symptomatic relief to the patient, to the extent that unaided he was able to raise himself in bed, was repeated several times. The cultures of the pus removed after each aspiration,—March 6, 10, 24, etc.,—however, still continued to show pneumococci in large numbers. The specimen of March 6 was injected into a guinea-pig for the

determination of tubercle bacilli. To eliminate the large number of pneumococci present, the aspirated pus was first carefully washed in a twenty-five per cent. solution of antiformin, centrifuged, resuspended, and then injected. To our great surprise, the laboratory reported this pig positive for tuberculosis at the end of six weeks. A second pig was thereupon immediately injected with a fresh specimen of the pus treated in exactly the same manner. After a suitable lapse of time, this pig was reported completely negative for tuberculosis. Since by this time the patient had left the hospital, a third injection was impracticable and we were left with our doubts unresolved.

On March 11, a sinus developed at the site of the first aspiration wound and during the period of two years that the patient was under observation, periodically opened to

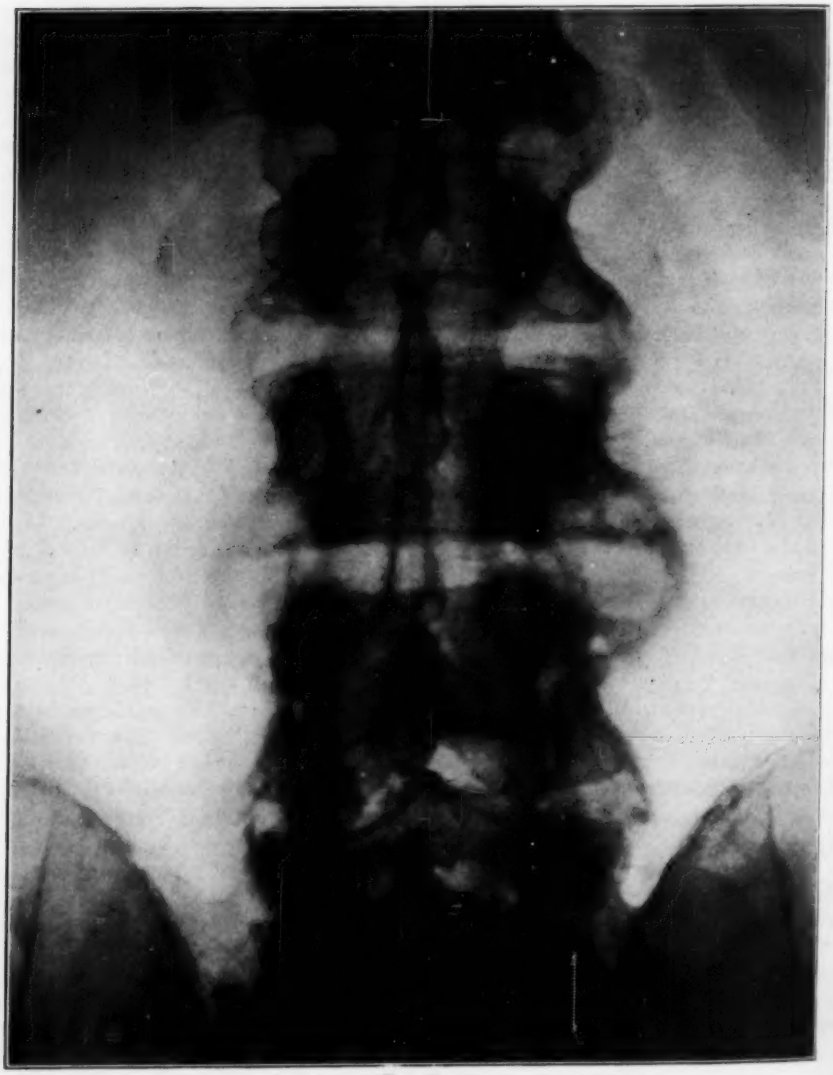

FIG. 1

Antero-posterior view showing bone-bridging, psoas abscess formation, and rarefaction of vertebral bodies.

permit of the discharge of varying amounts of pus. On this same date, because of the history of lues and the presence of a positive Wassermann, the consulting urologist advised the institution of active antiluetic therapy. In all, a total of four and eight-tenths grams of neosalvarsan was given in seven divided doses and at the end of this time the Wassermann test was still two plus. Though pneumococci could bacteriologically be demonstrated in the pus issuing from the sinus as late as about the beginning of April, cultures were negative and the patient seemed to show considerable clinical improvement. In the first week of June, the patient was able to walk about without pain, and on June 12 he was discharged to the Out-patient Department. During the succeeding two years he was seen at intervals in the Out-patient Department. The sinus ultimately closed permanently. At the end of about two years, the patient disappeared and we subsequently learned that he died of a cause which we could not ascertain.

FIG. 2
Lateral view.

By virtue of the repeated isolation of a specific type of pneumococcus, this case must be definitely considered as a pneumococcus spondylitis. While this fact alone is sufficient to recommend it to special attention, the interest in this case is undoubtedly intensified by the problem in differential diagnosis presented. In this instance only syphilis and tuberculosis entered into consideration. Clinically, the case presented all the criteria of a Pott's disease of the spine, from the preliminary diagnosis until the unexpected discovery of the pneumococcus by the bacteriologist. Apart from the clinical picture, the finding of tubercle bacilli in the pig first inoculated, was most suggestive of tuberculous infection. On the other hand, the negative Von Pirquet test, the repeated absence of tubercle bacill iin the specimens of pus examined, as well as the negative outcome of the second guinea-pig injection, seem to be of some importance in casting doubt upon this diagnosis.

Though the roentgenograms could by no means be considered as indicative of a tuberculosis of the spine, the evidence they presented of bone-bridging between the articulations of the lumbar vertebrae was equally valueless in definitely excluding this affection. In two separate communications[2, 3], Cofield has called attention to the fact that bone-bridging which has commonly been thought indicative of the non-tuberculous nature of the spinal disease may be seen not only in mixed tuberculous infections but even in uncomplicated cases of pure tuberculosis.

In a somewhat later article, Cofield and Little[4] observed that the gummatous type of syphilis of the spine may closely resemble tuberculosis of the spine. Both attack the body of the vertebra, lead to thinning of the body, disappearance of the intervertebral disc and the formation of cold abscesses. In the early stages bone formation does not occur, but in the later stages of both diseases typical and characteristic bone-bridging may be found. Though we do not believe that ours was a case of the gummatous type of spinal lues, it may well be that the lues, which this patient contracted and of which he gave proof in the presence of a positive Wassermann, may have been the substratum upon which the pneumococcal and the possible tuberculous infections subsequently developed.

In the matter of treatment, it seems to be the consensus of the authors who have written on pneumococcal infections in other joints, that in the stage of frank pus formation, incision and drainage is the procedure of choice. We have always had the impression that, as in tuberculous infections, open drainage was to be avoided as long as possible because of the danger of a supervening secondary infection by any of the commoner pyogenic organisms. As a result, we attempted the treatment of this patient by aspiration as soon as there was a demonstrable accumulation of pus in the abscess cavity. That this procedure was not entirely satisfactory was shown by the fact that within a short time a sinus tract developed, presumably along the path of an earlier aspiration puncture. Whether the condition could have been handled as safely and more expeditiously by open operation, we cannot say. The use of the optochin for the purpose of irri-

gating the cavity was certainly not harmful, but its specific effect upon the pneumococcal infection seemed to be questionable. After several injections, culture of the pus gave no growth, though pneumococci could be still demonstrated on the slide. Whether this resulted from the use of the optochin or as a result of the normal defensive response of the body, we cannot say.

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FRACTURE OF SESAMOID BONES OF THE FOOT

With Report of a Case*

BY MARCUS H. HOBART, M.D., F.A.C.S., EVANSTON, ILL.

Associate Professor, Department of Surgery, University of Illinois Medical School. Attending Staff, Cook County Hospital and St. Luke's Hospital, Chicago; Evanston Hospital, Evanston, Illinois

The following case report is of special interest because so few similar cases have been reported in the literature.

CASE REPORT

December 4, 1926; C. H., white, male, aged forty-two years, a painter, came to the Cook County Hospital with the following history. Four days previously, while working on a ladder on the side of a house, he stepped down from one round of the ladder to the next. The next round of the ladder, however, was missing and his foot came down forcibly upon the second round, striking the ball of the foot under the great toe with resulting sharp pain in that region. Upon walking, the pain was so severe that he consulted a doctor, but was not relieved. Accordingly, being only a poor painter making from ten to fifteen dollars a day, he repaired to the County Hospital, where upon examination he was found to be tender on the plantar surface of his foot under the metatarso-phalangeal joint.

The x-ray showed the fracture of the fibular (outer) sesamoid (Fig. 1). The fact that no case of congenital division of the fibular (outer) sesamoid bone has been reported, made the diagnosis of fracture in this case more certain.

The patient was put in a plaster-of-Paris cast, extending from beyond his toes to the knee, and was told to use crutches. The cast was not split as there was no swelling. He was told to report if any adverse symptoms arose, and at least once a week otherwise. The cast was split after four weeks and gradually the foot was released. At the end of six weeks no pain or tenderness was present and the patient could walk with ease and comfort.

Fracture of the sesamoid bones of the foot was noted in animals before any was reported in man. Schunke in 1901 was the first to describe a fracture of these sesamoids in humans[15].

In 1912 Müller[10] collected sixteen cases from the literature including one of his own. In one the fibular or outer sesamoid was involved, in nine the tibial, and in five a division was found in both feet.

Orr[12] collected twenty-four cases of fracture of the sesamoids up to 1918. Since that time there have been several articles and reports on fractured sesamoids of the great toe.

Delangenière[3], in an article on fracture and treatment of the internal sesamoid of the great toe, found no cases reported in the literature before

*Case presented at meeting of Clinical Orthopaedic Society at Chicago, October 1928.

that reported in 1909 by R. Morian. He cites a case[18] of fracture of the internal sesamoid, treated successfully by removal of the bone. He had two cases of the same bone fractured and similarly treated.

In the discussion following this paper Mouchet[9] observed that the diagnosis of a fractured sesamoid bone should be very guarded, because there are many anomalies of the internal sesamoid showing bipartite and exceptionally tripartite sesamoids.

Koch[8] reports two instances of fracture of a sesamoid bone of the great toe treated by rest, early massage, and hot air.

E. Müller[11] gives a case of a fracture of both sesamoids of the big toe.

Bizarro[1] reports two cases of sesamoid fracture, one a T-shaped fracture of the fibular (outer) sesamoid which showed bony union by an x-ray six months later. He collected sixty cases from the l terature in which six were fractures of the fibular sesamoid, one was of both, and the rest were tibial (inner) sesamoids.

FIG. 1

FIG. 2

Brugman[2] discusses fractures of the sesamoids as a source of pain around a bunion joint.

A fractured sesamoid without trauma is quoted by Hernaman-Johnson[6]. One might think of a congenital condition in this case.

Freiberg[4] discusses injuries of the sesamoid bones of the great toe in the Journal of Orthopaedic Surgery in 1920.

Other writers in the Archives of Radiology and Electrotherapy (London) in 1918 discuss fractures and congenital aspects of these sesamoids[5, 14, 16].

In considering the etiology of these fractures the mechanism is not always clear. On the cadaver[1, 13] it has been proven that forcible dorsiflexion and abduction of the great toe may give rise to fractures of the tibial sesamoid, and marked comminution may come from hammering on the foot with or without the shoe on. The cause may, therefore, be either direct or indirect violence and usually comes[7] from a sudden fall upon the feet or a heavy weight dropping upon the toe.

Roberts and Kelly[13] give the usual causes as resulting from direct violence,—as jumping on the toes, run-over accidents, sudden falls upon the feet, and the impact of falling objects on the foot, stepping off stairs and causing extreme toe hyperextension, hitting foot against a rock while running, dancing or skating accident, catching the foot in a hole, or making a false step on uneven ground. Most authors agree that the cause is usually direct violence.

Speed[19] summarizes the causes as follows:

(1) Direct violence due to the fall of heavy objects upon the foot.
(2) Squeezing the hallux between heavy masses.
(3) Fall from a height on to the foot.
(4) Sudden increase in weight-bearing force, when carrying heavy weights.

An association with hallux valgus is often found.

The symptoms are usually those of a sudden sharp pain at the time of injury and following some of these accidents, and is due to a low-grade inflammation of the adjacent joint with which the sesamoids are in the most intimate relation[7]. The pain is located in the region of the sesamoid bones and is associated with movements of the metatarso-phalangeal joint of the great toe; it may be less or absent on rest, but returns on walking. The pain is persistent on walking on the plantar surface of the foot over the sesamoid region, so that the patient will often walk on the outer side of the foot. Tenderness is associated with the pain, and is located over the sesamoid, is elicited by walking or direct pressure on the plantar surface.

Perhaps the most interesting and important part about the fracture of the sesamoid bones of the foot has to do with the diagnosis, and whether or not there is really a fracture present. The chief cause for confusion is the fact that congenital separation or non-union of the sesamoid bones occurs. The inner or tibial sesamoid is congenitally transversely divided in four per cent. of cases[1]; an extra sesamoid is present in perhaps one per

cent. The outer sesamoid was not seen congenitally divided in 100 cases. As a rule these congenital conditions show a smooth, rounded, and regular shape to the parts[17], while the fracture edges are dentate, irregular, and may be in any direction. The congenital are usually transverse, rarely oblique or longitudinal. The degree of separation is more apt to be greater in fractures. These conditions may be reversed, and pain may also be associated with the congenital type.

In making a diagnosis of fracture of the sesamoid, the history of the sudden sharp pain at injury with continued resulting pain and characteristic tenderness in a previously normal foot, and the x-ray are the most important points. An x-ray of both feet should be made for comparison, and the line of cleavage, its degree of separation, and character should be noted. The foot may be slightly swollen about the great toe joint and tenderness should be elicited by directed pressure with the thumb or finger over the fractured bone. If after proper treatment the symptoms have gone and x-ray shows union of the fracture, the diagnosis is assured. Of course, if there happened further to be an x-ray showing a normal sesamoid previous to the injury and symptoms, the diagnosis is certain.

The prognosis is good with proper treatment. Six to eight weeks should give a perfect recovery in most cases.

The treatment is rather well defined. The patient should be kept off of the injured foot and it should be immobilized until the fracture is healed, usually from three to six weeks. This immobilization can be done with a plaster-of-Paris cast, which may include the great toe. Koch[8] recommended rest, early massage, and hot air.

If the immobilization treatment fails or if the symptoms persist, removal of the affected sesamoid bone or bones is indicated. The operation is not too difficult. An incision is made preferably at the side of the foot so that the plantar surface is not interfered with. In the cases reported in the literature, operation was used in many.

SUMMARY AND CONCLUSION

1. Fracture of the tibial (inner) sesamoid of the great toe, although not common, has been reported often enough since its recognition to be classed as a clinical entity.

2. Fracture of the fibular (outer) sesamoid is rare and has been reported only a very few times.

3. Congenital anomalies of the tibial (inner) sesamoid occur in about four per cent. of cases.

4. No cases of congenital anomalies of the fibular (outer) sesamoid have been reported.

5. This case of fibular (outer) sesamoid is of interest as being very unusual.

6. The diagnosis of fractured sesamoid in this case is more certain because congenital anomalies of the fibular (outer) sesamoid have not been reported; and is proved by the x-ray taken.

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AN ANALYSIS OF A SERIES OF FRACTURES

Treated in the Surgical Unit of the Department of Clinical Surgery, University of Edinburgh

BY WALTER MERCER, F.R.C.S., EDINBURGH, SCOTLAND

From the Department of Clinical Surgery, University of Edinburgh

There is a deeply rooted conviction among the readers of surgical journals that the treatment of fractures in general does not bear any very searching investigation, and that the majority of results are bad, both anatomically and functionally. No doubt this feeling, already a seedling, was brought to a healthy and vigorous growth by a much discussed lecture of Sir Robert Jones, delivered a few years ago at the University of Liverpool. He said, "Our position today is tragic, for the majority of fractures treated by conservative or non-operative measures are badly united, with resultant disability. The treatment of fractures is at present a blot upon our surgical escutcheon." He then went on to criticize our big teaching hospitals, pointing out that our out-patient fractures are treated by junior officers with little or no experience, while the recumbent and severer cases admitted to the hospitals are scarcely, if at all, better off, in that they are so often left to the care of the house surgeon.

Somehow this sweeping condemnation rankled, and the author wondered, as others must have done, if Sir Robert really meant it all. Was it only his method of making us take a greater interest in fractures? Perhaps it was; and if so, he has succeeded.

The writer has searched the literature, endeavoring to find results of the total fracture work of any clinic, but so far, has not been successful. Many articles are published on the results of treatment of a single type of fracture, or of a single bone, but it is unusual to find a critical discussion of all the fracture work done in a single clinic.

Every surgeon has his individual views in regard to the treatment of fractures. Some choose to wire the patella, others practise the medullary-peg graft, and so forth; but the critical test is to analyze, not the particular type in which we are interested, but all the cases that are admitted to the ward during a given period,—the analysis to be made many months after that period has elapsed, so that we can have some idea of the end results obtained.

As a basis for the analysis in this paper, the writer has taken the period from April 1, 1925 to March 31, 1926, the first year that he was attached to the wards and so had an opportunity of caring for what one might term "major" fractures. A considerable period has elapsed since the original treatment of the cases, so that one is enabled to estimate what the permanent result is likely to be, and, with that result in one's mind, to

decide whether there is a reasonable foundation for the depression which appears to exist on the subject of fracture treatment by the general surgeon.

Every fracture admitted during this period has been included in the analysis. It must be understood that many of the cases are of a particularly severe type,—especially those cases affecting the arm and forearm,—because, had they not been severe, these patients, in the natural course of events would have been treated as out-patients in the Surgical Casualty Department. One may say the same about certain cases of fractures below the knee, for many of these fractures of the milder degrees are treated in the Out-patient Department by a plaster casting and sent home.

The writer has made it a rule to regard any severe fracture admitted to the ward as a condition as serious to the patient in its end results as is an acute abdomen. This means that the admission of a fracture is at once notified to the surgeon-in-waiting and treatment at once embarked upon. This is an essential in the treatment of fractures if one is to obtain the best results. Not only in the treatment of compound fractures, but in the treatment of simple ones, every hour of delay before the treatment is instituted means a less satisfactory result. This particularly refers to severe comminuted fractures in the vicinity of joints. Many of the cases are the result of industrial accidents, which come straight from the factory or from the pit, and usually there has been very little in the way of preliminary splintage or any attempt at reduction.

OBJECTS OF TREATMENT

Throughout, the object has been to obtain a good functional result and for this we have found that anatomical perfection was not essential and, where this has been difficult to attain, we have rather waived the point. In addition to a good functional result, we have endeavored to get the patient back in the labor market at the earliest possible date, so that gradually we have been reducing the various times of immobilization, and instituting movements of joints and massage at an earlier period in the cases towards the end of the period under review than in the earlier ones.

GROUPING OF CASES

The results are grouped as good, moderate, and bad. The good result is one where there is no disability and where the patient is now able to carry on his ordinary vocation and earn a wage similar to what he earned prior to his accident.

The moderate result is one in which there is some slight deformity or in which there still remain some symptoms of the accident, but where, in spite of this, the patient carries on his ordinary occupation without difficulty.

The bad case is one in which there is a deformity or shortening, or in

which the joint is limited to such an extent that the previous occupation is now impossible.

To afford some rough idea of the patient's ability for work before and after the injury, a table is given with each type to show the results at a glance. An attempt is made to compare results with those of other observers, but this has been difficult because collective records of fractures of various types are rarely published. The comparisons are therefore made by groups, and the likelihood is that the results of this series may seem at a disadvantage, as one imagines that the publishing of results of one type of fracture implies a particular interest in that fracture, and therefore a special care in its treatment.

One of the peculiar values of such a paper as this, it is hoped, will be to give some idea of the prognosis of a fracture, a point of great importance in Insurance and Workmen's Compensation cases. How often one is asked, "Will I manage my job, Sir?" or "Will I be fit for my work?". Information on such questions is often omitted in textbooks.

It is of the utmost importance in these days of overcrowded wards and long waiting lists, to reduce the period of in-patient treatment to a minimum and to some extent this has had its effect on our methods of treatment; and so perhaps plaster-of-Paris occupies a place somewhat more prominent than may be its due.

A liberal use has been made of photographs in the illustration of this article; they are more descriptive and less confusing than words.

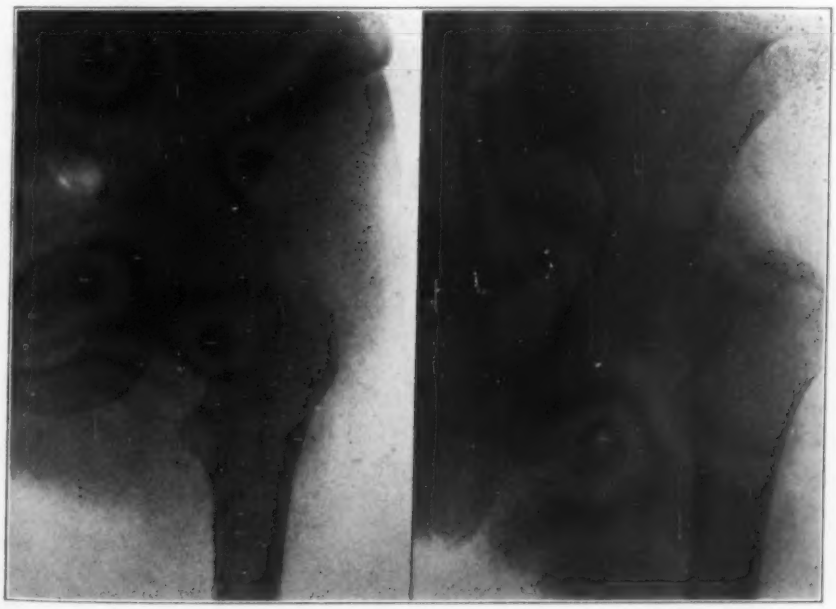

FIG. 1

Case 1. Fractured neck of the femur. Treated by abduction plaster. Good union and function.

FIG. 2

Case 1. Fracture of the neck of the femur. Abduction plaster. Occasional pain in damp weather. Good union.

FIG. 3

Case 2. Fracture of the neck of the femur. Weight extension. Good union. Slight stiffness of knee.

FIG. 4

Case 4. Fracture of the neck of the femur. Abduction plaster. Good union but occasional pain in the joint.

FIG. 5

Case 5. Fracture of the neck of the femur. Abduction plaster. Good union. Does not have complete flexion of knee.

FRACTURES OF THE FEMUR

During the period under review, eighteen cases of fracture of the femur were admitted to the wards, eleven of these being of the neck, six of the shaft, and one a fracture dislocation of the lower epiphysis. For the purposes of this paper we have divided these fractures into two groups: (1) fractures of the neck of the femur; and (2) fractures of the shaft, to which the fracture dislocation has been added.

FRACTURES OF THE NECK OF THE FEMUR

Method of Treatment

To some extent we have been influenced in our treatment of these cases by the older textbooks which regard this injury from two points: (1) the saving of life; and (2) the restoration of function. In all cases the question of life should have first consideration. Where the life was in no danger, and the patient was a fairly good risk, our treatment has been along the lines laid down by Whitman. It has been felt that the earlier this treatment is instituted, the greater is the likelihood of a satisfactory union taking place, so that in this type of fracture, as in the others, an endeavor has been made to reduce and fix the disability as soon after the admission of the case as the shock of the accident will permit. These cases have usually been admitted with a marked amount of shortening

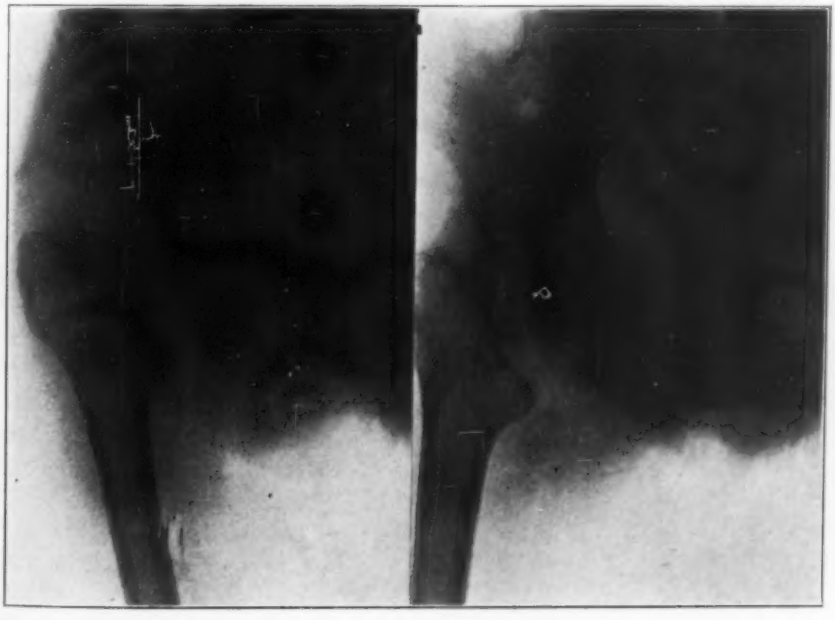

FIG. 6

Case 6. Fractured neck of the femur. One-half inch of shortening but with good function.

and with no splintage applied. The patients are undressed and put to bed, and the shock cage put over them, while the usual stimulants, where necessary, are given. In most cases a radiogram is taken before they are admitted to the wards and the wet plate seen shortly after their admission. Thereafter, they are seen by the surgeon, when the general condition is taken into account, and the type of treatment to be carried out is decided upon.

In using the Whitman method it has been found that a rectangular window cut in the plaster to expose the patella and quadriceps tendon is useful in promoting subsequent movements of the knee. The patella can thus be moved every day and voluntary contractions of the quadriceps muscles encouraged.

Some of our cases, by reason of age or general ill health, were unsuitable for plaster, and were treated either by weight extension or merely by sandbags. But perhaps the fact that we paid close attention to the general condition of the patient has had some effect upon our mortality rate, for of the eleven cases admitted there was no mortality. All the patients were female. Their ages varied from forty-two to eighty-two, the average age being fifty-eight and five-tenths years. It is an interesting fact that the left femur was affected in eighty-two per cent. of the cases.

In attempting to arrive at an explanation of the unsatisfactory results obtained in certain of the cases, we found that two of the cases which developed non-union owed their condition to the fact that one was admitted a fortnight after the fracture and the other seven weeks after. A third case developed acute obstruction and as a consequence had to have the plaster removed. One patient aged seventy-three, and one aged eighty, were in such poor condition that we did not seriously hope for union from the first. Of the remaining six cases, all but one of which were treated by a plaster cast, four showed a good union of the fracture with one-half inch, three-quarters inch, three-quarters inch and one inch of shortening respectively. All of these latter patients are now working, and state that, except for occasional pain in damp weather, and, in two cases, some stiffness of the knee, they have no disability. It is only fair to state that in two of these cases the fracture was nearer the base of the neck than the middle. Of the eleven cases,

FIG. 7

Case 11. Fracture of the neck of the femur. Abduction plaster. No disability, but has only fibrous union.

therefore, the analysis is:—two untraced; four good results with bony union and working at their old occupation; two moderate, that is with fibrous union and working; three bad results, two of whom, however, are able for some work.

It is perhaps difficult to compare these final results with results published by other observers, but a glance at the table of these fractures shows that eight of the cases are able for work of some sort, while, of the other three, two have not been traced, and one walks with sticks and is unable for work, she being the patient who was admitted seven weeks after the fracture. Ashhurst[1] recently published a paper based on 111 cases, of which eighty-nine per cent. were traced. Sixty-three per cent. of his had no functional disability whatever; thirty per cent. had moderately good functional results; and only seven per cent. were totally incapacitated. Campbell[2] reported seventy cases, six per cent. of which showed non-union; while Dorrance and Murphy[3] reported twenty cases, of which nine had full function, three showed a slight limp but were capable of walking, five used a stick, and two died. Moore[4] reports a series of forty-two cases treated by a special plaster of his own contrivance, where the leg was put in plaster at a right-angled flexion of both hip and knee. He states that sixty per cent. of these cases gave a "good result". The Committee on Treatment of Simple Fractures of the British Medical Association show the following results obtained in fractures of the neck of the femur. Number of cases, ninety-one. Anatomical results:—good, eighteen; moderate, eighteen; bad, thirty-nine. Functional results:—good, twenty-four; moderate, twenty-eight; bad, thirty-nine.

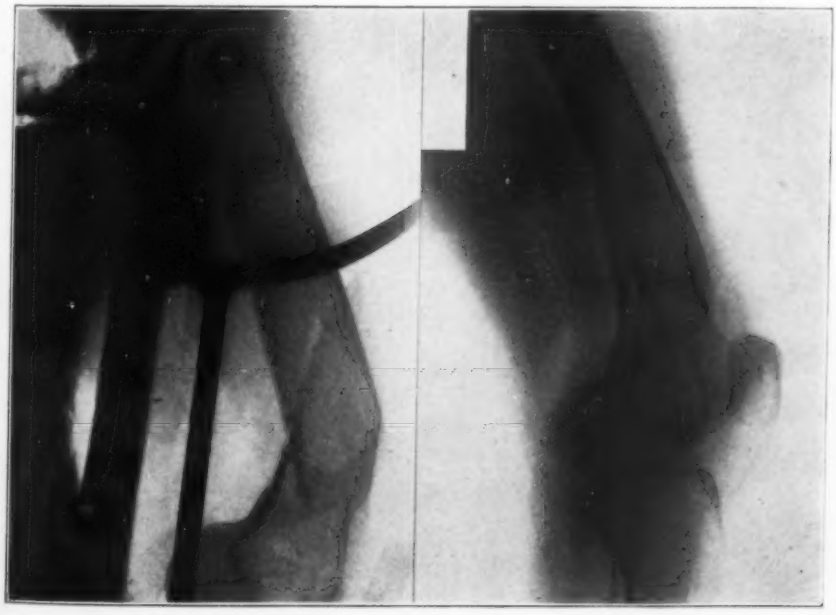

FIG. 8

Case 12. Supracondylar fracture of the femur. Treated by Thomas splint. No shortening. Good result.

TABLE 1

FRACTURES OF THE NECK OF THE FEMUR

	Name	*Age*	*Sex*	*Side*	*Site*	*Treatment*	*Occupation*	*Symptoms*	*Union*	*Shortening*	*Class*	*Ability for Work*	*Remarks*
	N. M.	57	F.	L.	Neck	Plaster 9/52*	Housewife	Pain in damp weather.	Yes +	1 in.	G.	Working	
2	M. M.	65	F.	L.	Neck base	Weight ext.	Housewife	Little dif. in bending knee.	Yes +	¾ in.	G.	Working	
3	C. W.	55	F.	L.	Neck	Plaster 1/52	Housewife	Pain in damp weather.	No −	¾ in.	B.	Sitting job now	Developed acute obstruction.
4	M. R.	54	F.	L.	Neck-impacted	Plaster 10/52	Housewife	Pain in joint.	Yes +	½ in.	G.	Fit as before	Rheumatoid arthritis case.
5	J. McV.	44	F.	L.	Neck	Plaster 7/52	Housewife	Slight stiffness in knee.	Yes +	¾ in.	G.	Working	
6	I. H.	42	F.	R.	Neck-impacted	Undone and plaster 7/52	Housewife	Slight stiffness in knee.	Fibrous	½ in.	M.	Working	
7	J. R.	60	F.	R.	Neck	Plaster 8/52	Domestic	Limp	No −	1¼ in.	B.	Working	Admitted 14 days after fracture.
8	E. T.	82	F.	L.	Neck	Sandbags	Nil	—	—	—	U.	—	
9	M. M.	55	F.	L.	Neck	Nil	Housewife	Walks with sticks.	No −	1 in.	B.	Not working	Admitted 7 weeks after fracture.
10	A. F.	73	F.	L.	Neck	Weight ext.	Housewife	—	—	—	U.	—	
11	M. E.	59	F.	L.	Neck	Plaster 10/52	Housewife	None except shortening.	Fibrous	½ in.	M.	Working	

Average 58.5
Good 4 Moderate 2 Bad 3 Untraced 2 = 11.

*9/52 indicates 9 weeks.

TABLE 2

FRACTURES OF THE SHAFT OF THE FEMUR

	Name	*Age*	*Sex*	*Site*	*Treatment*	*Occupation*	*Symptoms*	*Union*	*Shortening*	*Class*	*Ability for work*	*Remarks*
12	E. D.	51	F.	Supracondylar	Thomas + weight	Housewife	None	Yes	None	G.	Working	
13	G. C.	18	F.	Shaft—mid.	Banded	Shop Asst.	None	Yes	⅝ in.	M.	Working	
14	I. F.	49	M.	Shaft + upper third	Thomas + weight	Carter	None	Yes	¾ in.	B.	Working	Developed delirium tremens and destroyed plaster.
15	A. S.	5	M.	Shaft — mid.	Gallows splint	Schoolboy	None	Yes	None	G.	At school	
16	J. W.	14	M.	Supracondylar separation of epiphysis.	Operation and plaster	School	None	Yes	None	G.	Working	
17	W. S.	22	M.	Shaft — mid.	Bone graft	Engineer	Died	—	—	D.	—	
18	J. G.	30	M.	Shaft + upper third	Bone graft	Engineer	Stiff knee	Yes	None	M.	?	Admitted 8 weeks after fracture.

Good 3 Moderate 2 Bad 1 Died 1 = 7.

FIG. 9

Case 13. Fractured shaft of the femur treated by Parham bands. Showing the movements. Functional result perfect but five-eighths inch of shortening.

FIG. 10

Case 18. Old fracture of shaft of femur, with malunion. Treated by Lane plate. Good result of fracture.

FRACTURES OF THE SHAFT OF THE FEMUR

There were seven cases under this heading during the period under review. Five of the fractures were situated in the middle of the shaft, one was a supracondylar fracture, and one was a separation of the lower epiphysis. In this series there was one death, which followed an operation for bone-grafting in a patient who had multiple injuries. He had a fractured skull and perhaps his operation was done too soon after the original injury, for death occurred and the postmortem examination showed a further cerebral hemorrhage. In none of the remaining cases was there non-union. In four of the cases there was no shortening, while of the other two the shortening amounted to five-eighths inch and three-quarters inch respectively. The case in which there was three-quarters inch of shortening was that of a middle-aged carter who developed delirium tremens and tore off his weight extension on several occasions. Five of the patients were able for work and complained of no subsequent symptoms whatsoever. Four of the seven cases were operated on. One was the case already described; the second being a malunited shaft fracture, admitted as an old fracture from another hospital, which was reduced and bone-grafted. The third was an oblique fracture which was Parham-banded; and the fourth, the epiphyseal separation which required operative treatment.

In no case of this series have we experienced any trouble from infection, either following operative interference or the use of Pearson's caliper. One case of the series was that of a boy of five, who was treated by means

of a gallows splint and, as was to be expected, gave a perfect functional result.

It will be seen, therefore, that in three of the cases the result was perfect. In two a slight amount of shortening (⅝ inch and ¾ inch) was the only disability and in one some stiffness of the knee resulted. One naturally expects good results in fractures of the shaft of the femur and many striking figures have been published. Campbell and Speed[5] reported on 153 cases, in which perfect or good results were obtained in ninety-eight per cent. of children and in ninety-five per cent. of adults. The Committee of Treatment of Simple Fractures of the British Medical Association showed that good results were obtained in the upper third fractures, in ninety-five per cent. of the patients under fifteen years of age; in seventy per cent. between the ages of sixteen and forty-five; and in thirty-one per cent. in patients over forty-five. In middle third cases, good results were obtained:—in ninety-seven per cent. under fifteen years of age; in fifty-eight per cent. between the ages of sixteen and forty-five; and in thirty-two per cent. over forty-five.

FRACTURES OF THE HUMERUS

During the period under review there were eight cases of fractured humerus and five of these had further complications, two of them being fracture dislocations and three being compound.

The five cases that were not compound were treated in the way advocated by Mr. J. W. Dowden. After the fracture is reduced so far as possible, the arm is put in a sling, care being taken to support the wrist rather than the elbow, so that the weight of the distal fragment takes its full part in maintaining alignment of the fracture. At night a posterior splint of Gooch is applied for a few nights, but this is soon unnecessary. The main part of the treatment is to encourage the patient to move his arm actively from the beginning. It is extraordinary how early he begins to use the arm and how quickly the arm be-

FIG. 11

Case 20. Surgical neck of humerus. Treated by reduction and sling. Perfect function.

gins to mend. So much confidence was placed on this method that it was advised and carried out successfully in a comminuted fracture of the surgical neck in the case of a one-armed man. Three additional cases were treated in this way and in two of them the result was perfect, there being no symptoms whatever present at the last examination. The result of the other case has been classed as moderate and this is due in great measure to the fact that seven weeks had elapsed before this patient came into the hospital for treatment. In addition to her fracture she had a dislocation of the head of the bone.

In the remaining cases, principally because of their compound nature, a modification of a Thomas ring splint was employed. It was used along with a right-angled forearm piece, so that the basic principle of early active movement was possible and was employed. If there was much overriding, it was thought that this splint reduced the error to a minimum during the early days of the treatment, and it was found that the correction was maintained when the splint was removed at the end of a week. Thereafter a sling was used.

FIG. 14

Case 23. Compound fracture, shaft of the humerus. Debridement and sling. Perfect function.

FIG. 12

Case 20. Fracture, surgical neck of humerus. No disability now whatever.

FIG. 13

Case 21. Fracture of surgical neck of the humerus. Reduction, sling and active movements. No disability now.

FIG. 15

Case 23. Compound fracture, shaft of humerus. Excision of wounds, sling and early active movements. No disability now.

FIG. 16

Case 24. Compound fracture of radius and ulna. Excision of wounds. Extension treatment. Much limitation of movement.

FIG. 17

Case 26. Compound fracture of shaft of humerus. Excision of wounds and extension splint. No disability now.

In all the compound cases immediate operation was resorted to, debridement being carried out. One of the cases showed an extensive wound of the elbow region, with a compound fracture of the radius and ulna, while the median and ulnar nerves were severed. It was only because we believed that the worst possible natural hand was better than the best artificial one that the limb was left in place. The result has justified this treatment. This patient has now perfect feeling in his hand and a remarkably good grip, following a double nerve suture. His joints, however, have stiffened up to a very considerable extent. This is the only case in which ability for work is diminished. Every one of the other patients is working now as before.

The results are classified in the usual three groups:—five cases good; two moderate; one bad. The two patients showing moderate results have resumed their occupations, one as a typist and the other as a housekeeper. The former had a severe supracondylar fracture with dislocation of the elbow; the latter had a dislocated shoulder which was reduced after seven weeks. In one case, illustrating a fractured surgical neck, the patient was fully employed seven weeks after the fracture and was then wielding a fourteen-pound hammer for several hours a day. In none of the cases was there any non-union or even delay in union.

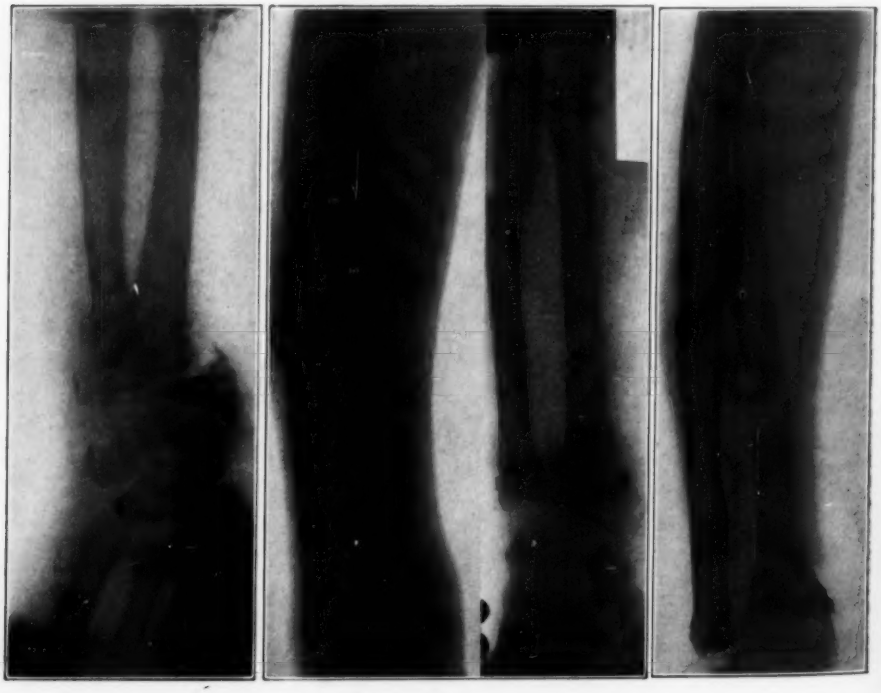

FIG. 18

Case 27. Compound fracture shaft of ulna and radius with a separated lower epiphysis of radius. Treated by debridement and wiring. Good functional result.

Santee[6] has published results of a consecutive series of seventy-five cases of fractures of the upper end of the humerus. He however only traced nineteen cases and, of these, fifteen had good shoulder function, two were fair, and two were bad. Van Bruns[7] records 376 cases of non-union in 1247 cases of non-union of all bones. Ashhurst's[8] reports of lower end results in forty-seven cases show eighty-one per cent. perfect, eight per cent. moderate, and ten per cent. bad. Cotton[9] has eighteen per cent. perfect, thirty-seven per cent. moderate, and forty per cent. bad, in a total of twenty-seven cases.

FRACTURES OF THE FOREARM

There were six cases affecting the forearm bones and the difficulty in treating them is reflected in the fact that it was necessary to operate

FIG. 19

Case 28. Compound fracture, radius and ulna. Debridement and peg graft. Good functional result.

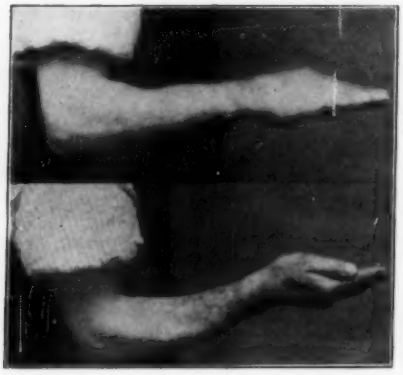

FIG. 20

Case 28. Compound fracture of ulna and radius. Excision and splintage. No disability.

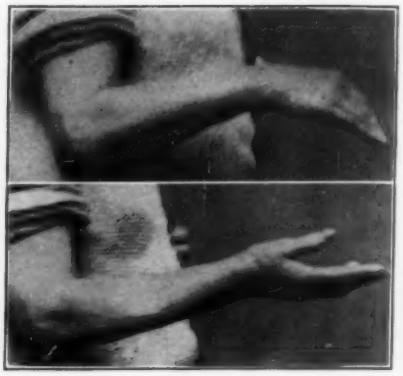

FIG. 21

Case 30. Compound fracture, both bones of forearm. Excision of wounds, antero-posterior splinting. Slight limitation of pronation.

on five of them, although in two of these cases a debridement only was done. All of the cases were of a severe type, as naturally the large majority of these fractures are treated in the casualty department and only the presence of some particular difficulty or complication brought them into the wards of the hospital.

Four of the six cases were compound, necessitating immediate operation and the opportunity was then taken to reduce the fragments. In two of the cases it was necessary to do a more radical operation to get a proper reduction of the fracture and in each an intramedullary bone peg of ox-bone was introduced at a later date. These two patients had received multiple injuries, the one having three fractures of the forearm and two of the humerus, while in the other case there were fractures of the shaft of the ulna and of the shaft of the radius and a bad displacement of the lower radial epiphysis. These cases were retained in extension splints similar to those used for a fractured humerus, traction being maintained to the forearm flexed to a right angle by means of a glove and a fixed extension of the Spanish windlass type. Beyond a slight degree of supination in one, there are neither symptoms nor deformity, and both patients are now fully employed. The other two compound cases healed by first intention following the operation and one gave a perfect result. The other case was that of a lady of sixty-five and the result was perfect, except that her fingers became rather stiff, so that she has a slight interference with full flexion of the fingers. The forearm is, however, good. In the cases of the two simple fractures, one was further complicated by a fractured skull followed by dementia, but this patient has only the slightest limitation of pronation of the forearm; while the second had a complete separation of the upper radial epiphysis, necessitating operative replacement but giving a perfect result.

It will thus be seen that of the six cases, three were perfect and three were classed as moderate, which in these cases only lacked being a com-

plete recovery by having a slight limitation of pronation of the forearm or of flexion of the fingers.

There seems to be no great anxiety to publish results of fractures of the forearm and perhaps the reason for this is not far to seek. In a recently issued textbook on fractures, the author begins his remarks on prognosis by saying, "Fracture of both bones is one of the most difficult fractures to treat". Dakin[10] is of the opinion that anatomical reduction is rare. The Mayo Clinic (Henderson[14]) publishes the treatment of fifty-nine cases of non-union of forearm bones in seven years. Martin and Eliason[11] studied 262 recent simple fractures and had seventy-four and four-tenths per cent. good results; twenty-one and five-tenths per cent. moderate; and four and two-tenths per cent. bad; while of sixteen compound cases the figures were: thirty-six per cent. good, thirty-six per cent. moderate, and twenty-four per cent. poor.

FIG. 22

Case 31. Separated proximal radial epiphysis. Operative replacement resulting in complete restoration of function.

TABLE 3

FRACTURES OF THE HUMERUS

	Name	*Age*	*Sex*	*Site*	*Treatment*	*Occupation*	*Symptoms*	*Ability for work*	*Class*	*Remarks*
19	L. B.	66	F.	Surgical neck + dislocation	Reduction + sling 7 weeks after	Housewife	Limitation of movement.	Working	M.	
20	A. C.	51	M.	Surgical neck	Reduction + sling	Fireman officer, one-armed.	None	Working	G.	
21	J. D.	45	M.	Surgical neck	Reduction + sling	Pit worker	None	Working	G.	
22	L. M.	20	F.	Supracondylar + disloc. elbow	Reduction + splint	Typist	Limitation of movement.	Working	M.	Admitted 4 days after injury.
23	A. K.	45	M.	Shaft, compound	Sling	Shunter	None	Working	G.	
24	J. H.	55	F.	Shaft, severe compound	Reduction operation and splint	Machinist	Much limitation of movement.	Not working	B.	Permanently unfit.
25	G. H.	23	F.	Neck	Reduction + splint for 2 days, then sling	Typist	None	Working	G.	
26	J. R.	47	M.	Shaft, compound	Reduction + splint	Laundryman	None	Working	G.	

Good 5 Moderate 2 Bad 1 = 8.

TABLE 4

FRACTURES OF THE FOREARM BONES

	Name	*Age*	*Sex*	*Site*	*Treatment*	*Occupation*	*Symptoms*	*Class*	*Ability for work*	*Remarks*
27	G. A.	14	M.	Compound fracture both shafts + separated lower radial epiphysis	Debridement + peg + wire	Pitboy	Slight limitation	M.	Working	
28	J. R.	47	M.	Compound fracture both bones	Debridement + peg + splint	Laundryman	None	G.	Working	
29	P. M.	35	M.	Compound fracture ulna	Debridement + anterior splint	Collier	None	G.	Working	
30	H. D.	65	F.	Compound fracture both bones	Debridement + A. P. splints	Housewife	Slight limitation	M.	Working	
31	H. B.	13	M.	Separated upper radial epiphysis	Operation—replacement	Schoolboy	None	G.	At school	
32	A. M.	29	M.	Shaft radius, fractured skull and dementia	A. P. splints	Collier	Slight limitation	M.	Not yet	Still incapacitated from brain injury.

Good 3 Moderate 3 = 6.

Good 3 Moderate 3 = 6.

TABLE 5

FRACTURES AT ANKLE JOINT

	Name	*Age*	*Sex*	*Site*	*Treatment*	*Occupation*	*Symptoms*	*Class*	*Ability for work*	*Remarks*
33	J. H.	28		Pott's	Reduction + plaster	?	—	U.	—	
34	W. C.	26	M.	Compound fracture Pott's	Debridement, reduction + box. Plaster later.	Draughtsman	—	G.	Working	
35	G. A.	32	M.	Malleoli	Reduction + plaster	Builder	—	G.	Working	
36	M. B.	36	F.	Comminuted both bones	Sectional plaster	Domestic	—	G.	Working	
37	E. E.	50	F.	Pott's	Plaster	Housewife	Slight pain	M.	Working	Transferred to other ward for emergency operation.
38	T. H.	27	F.	Pott's	Sectional plaster with gutter	Housewife	Pain occasional	M.	Working	
39	M. S.	51	F.	Malleoli with posterior displacement	Reduction + plaster	Housewife	Deformity and pain	B.	Working	Pain on walking; eversion, improved after treatment.
40	T. J.	14	M.	Tibial malleoli + fibular shaft	Reduction + plaster	Pitboy	—	G.	Working	
41	A. T.	58	M.	Pott's	Reduction + plaster	Railway inspector	—	G.	Working	
42	J. R.	66	F.	Median malleolus	Reduction and sandbags	Housewife	—	G.	Working	Severe blisters
43	W. F.	54	M.	Fibula—transverse	Reduction + plaster	Engineer	—	G.	Working	
44	R. M'D.		M.	Compound calcaneus	Box + debridement	Porter	—	G.	Working	
45	C. D.	52	F.	Both malleoli		Housewife	Died of bronchopneumonia	D.	—	
46	B. W.	45	M.	Median malleolus and fibula	Plaster	Laborer	—	G.	Working	

Good 9 Moderate 2 Bad 1 Untraced 1 Died 1 = 14

FRACTURES INVOLVING THE ANKLE JOINT

There are fourteen cases in this category, a group in which the fracture is often loosely termed a Pott's fracture. There has been no attempt to classify them into the various types—the adduction, the abduction, the external rotation fracture, etc.—but we have grouped them together and have, in fact, included a fracture of the os calcis, as this seemed a more appropriate group in which to include it than the miscellaneous one.

FIG. 23

Case 31. Separated upper radial epiphysis. Operative replacement. No disability now.

One patient died of an intercurrent bronchopneumonia after discharge from the hospital in a plaster case and one could not be traced. Of the remaining twelve cases there was one bad result in a woman of fifty-one whose fracture was reduced and treated in a box splint. A plaster was applied ten days later. This was subsequently removed by her doctor and she was not seen again for about seven months. She then had a slight eversion deformity and limitation of lateral movements. There are two moderate results, classed so because they both have a little pain if they are on their feet all day. All the remaining patients in this group have no deformity, pain, or limitation of movement and follow their usual occupations. Three of these good results were complicated during treatment by the condition of the skin. Two, the calcanean fracture and a Pott's, were compound, and the other did not permit of a plaster splint owing to a great number of blisters on the skin.

Whatever our view on the necessity or otherwise of anatomical reposition in other fractures, we have maintained that absolute anatomical

FIG. 24

Case 33. Pott's fracture. Reduction and plaster. No disability now.

FIG. 25

Case 35. Fracture, both malleoli. Reduction and plaster. No disability now.

replacement is necessary in this type of fracture. Anaesthesia is always necessary in the reduction if there is any displacement; and the sooner the manipulation is carried out, the easier it is and the greater is the likelihood of absolute replacement.

In severely comminuted cases, the greatest difficulty was sometimes found in maintaining the reduction long enough to apply the plaster. This difficulty was overcome, however, by the use of a sectional method of plaster application suggested and used by a French surgeon. After the limb is clothed in a wadding bandage (we often use the bandage of this material suggested by Platt of Manchester) or boric lint, a plaster shoe is applied to the foot and the leg is enclosed in a legging of plaster extending from just above the ankle to above the knee, the latter being flexed meantime. These separate plasters are allowed to harden and then the fracture is completely reduced and held in accurate position by the operator, while an assistant binds the two sections by another plaster bandage. The leg is held firmly until the whole plaster is hard enough to maintain the position.

The great majority of fractures are reduced and encased in plaster practically at once and before any great amount of swelling has taken place. It is considered inadvisable to bivalve the plaster until the fracture is be-

FIG. 26

Case 36. Comminuted fracture of ankle joint. Reduction and sectional plaster. Complete restoration of function.

FIG. 27

Case 36. Showing the method of application of plaster to leg fractures.

ginning to become firm, but to avoid any risk from swelling a gutter about one and one-half inches wide is cut down the whole length of the front of the plaster and under this the lint is cut so as to expose a length of skin from knee to toes. A troublesome skin sore can be produced by the tight bandaging of lint, even though the plaster itself is cut or bivalved. The gutter permits a certain amount of "give" in the plaster, and any undue feeling of tightness can be remedied by forcing out the sides of the plaster, while still maintaining a very accurate position.

Of our fourteen cases, one was not traced and one patient died. The remainder were classed as:—good, nine; moderate, two; and bad, one. As a comparison with our results we quote Haenel's[16] statistics of ankle fractures, based on forty cases. His series showed twenty-eight recovered (70 per cent.); twelve disabled (30 per cent.); and the average loss of working efficiency of these patients was fifty per cent. He thinks that convalescence is often prolonged by persistent oedema, stiffness of the joint, and atrophy of muscles, due to prolonged fixation. With this the author entirely agrees.

Ferry[12] discusses forty-two bimalleolar and Dupuytren's fractures and found as a late result normal function in all except one. In two of his cases which were compound there was "vicious callus and serious foot deformity" so that he had to do astragalectomies.

Ashhurst[13] traced seventy-two per cent. of his cases in a recent paper and found that seventy-two per cent. gave a good functional result, twenty-six per cent. moderate, and two per cent. bad.

FRACTURES OF THE TIBIA AND FIBULA

Cases coming under this heading were treated on much the same lines as those involving the ankle joint,—that is, by immediate reduction and retention in a plaster-of-Paris case. In four cases, owing to various reasons, splints were used in the first instance. One was badly blistered, having arrived some time after the accident; one was compound; a third had an injury to the main vessels and required careful watching; while the fourth, it seemed, had too much swelling for the plaster to be safe at first or effective later on. In three of these cases a box splint was used, while a McIntire splint was applied to the last. If extension is demanded

in fractures of this type, a Finochietto caliper over the os calcis is used frequently but it so happened in this period there were no cases demanding this procedure.

Operative treatment was carried out in two cases, and both were compound fractures requiring excision of the wounds. One of these was prepared for amputation, but at the last moment it was decided to give the limb a chance. The limb has been saved with good movement to knee and ankle but there is no union at the tibial fracture, principally owing to great loss of bony substance. This case was put up in the first instance in a Thomas ring caliper with bent knee piece and extension maintained by a Sinclair's foot piece. A big loss of skin was, at a later stage filled up by a pedicled tube skin graft from the other leg. This case has been classed, naturally, as bad, though, all things considered, it is rather a good result.

All the simple cases were reduced and put up in the guttered splint for ten days. In two of the cases the position, as shown by x-ray, necessitated a further reduction. The leg is put up with the knee slightly flexed, the foot at a right angle and very slightly adducted. Great care

FIG. 28

Case 36. Comminuted fracture, both bones of the leg. Reduction and sectional plaster. No disability now.

FIG. 29

Case 37. Pott's fracture. Reduction and plaster. Occasional pain now. No limitation of movement.

FIG. 30

Case 38. Pott's fracture. Manipulation and sectional plaster. No disability now.

is taken to prevent any rotation of the lower fragment. Absolute end-to-end apposition is not insisted on, but perfect alignment is sought. At the end of ten days the plaster is bivalved, and the patient measured for a short caliper splint, although walking is not permitted till the fifth or sixth week or even longer in the case of an oblique fracture.

Of the twelve cases, there are eight good results, three moderate, and one bad. Of the moderate results one has a slight limitation of complete knee flexion; one has slight pain on walking and one-quarter inch shortening, but no limp; while the third complains of occasional stiffness in the leg, although he is a shepherd and walks many miles every day. Every one of these patients is back at his old occupation, though the one classed as bad is at a somewhat lighter branch of coal-mining, his previous occupation being at the coal face.

FIG. 31

Case 40. Abduction fracture at ankle. Reduction and plaster. Has some pain and slight deformity.

TABLE 6

FRACTURES OF THE LEG BONES

	Name	*Age*	*Sex*	*Site*	*Treatment*	*Occupation*	*Symptoms*	*Class*	*Ability for work*	*Remarks*
47	E. B.	35	F.	Oblique, shaft tibia—comminuted	Reduction + plaster	Housewife	None	G.	Working	
48	C. S.	54	F.	Tibia, oblique	Box, owing to blistering	Housewife	¼ in. shortening	G.	Working	
49	J. C.	49	M.	Tibia, transverse	Box, owing to swelling	Laborer	Slight limitation of movement with slight limp	M.	Working	
50	W. S.	42	M.	Tibial head, severe comminution	McIntire, owing to doubt about artery. Reduction + plaster	Blacksmith	¼ in. shortening Slight pain	M.	Working	The vessels were compressed and there was a fear of arterial damage.
51	J. H.	50	M.	Compound fracture both bones	Debridement, reduction and box	Compositor	None	G.	Working	
52	M. A.	7	F.	Comminuted head of tibia	Reduction, plaster, manipulation later	School	None	G.	At school	Imperfectly reduced at first and operated on later.
53	S. R.	8	F.	Oblique tibia	Reduction + plaster	School	None	G.	At school	
54	W. W.	20	M.	Transverse tibia	Reduction + plaster	Plumber	None	G.	Working	
55	H. M.	57	M.	Tibia	Reduction + plaster	Shepherd	Occasional stiffness	M.	Working	
56	A. S.	38	M.	Fibula	Reduction + plaster	?	None	G.	Working	
57	–. B.	28	M.	Compound fracture—tibia and fibula	Debridement	Miner	Non-union	B.	Working	
58	–. O'D.	31	M.			Miner		G.		

Good 8 Moderate 3 Bad 1 = 12

FIG. 32

Case 40. Internal malleolus and fibular shaft. Reduction and plaster.

FIG. 33

Case 41. Pott's fracture. Reduction and plaster. No disability now.

For purposes of comparison, we note that the Committee on Fractures of the British Medical Association shows that in closed fractures of both bones the percentage of good anatomical-functional results by non-operative means was forty-four and four-tenths per cent.; by operative means, sixty-three and six-tenths per cent.; that good functional results with poor anatomical results were obtained in seventy per cent. by non-operative means and sixty-eight and one-tenth per cent. by operative means; while in fractures of the tibia alone the percentage was respectively seventy-four and four-tenths and seventy-six and four-tenths. Ashhurst found that seventy-one per cent. of his traced cases had a good result, twenty per cent. were moderate, and nine per cent. were bad.

MISCELLANEOUS FRACTURES

In this group are included one case of a fractured clavicle, two cases of fractured olecranon, and two fractured patellae. The clavicle case was admitted owing to the complication of a head injury and was treated by a sling and active movements from the first, and, as was to be expected, gave a perfect result. One of the olecranon cases was the result of a direct injury with some damage to the skin. This was allowed to heal and an operation was carried out to wire the widely gaping fragments. There must have been infection still in the deeper layers, for the joint became infected and an ankylosed elbow has resulted. The other olecranon was wired in the usual way and gave a perfect result.

CONCLUSIONS

From the table of results of the complete series, it is to be seen that statistics are based on sixty cases, as there were three cases that could not be traced and so were not included, although the last information about these was that they promised to be very satisfactory in their end results. The total number of beds at the disposal of this department is fifty with an additional four cots. During the year under review a total of 981 cases were treated. It is therefore interesting to know that sixteen per cent. of these

TABLE 7

MISCELLANEOUS FRACTURES

	Name	*Age*	*Sex*	*Site*	*Treatment*	*Occupation*	*Symptoms*	*Class*	*Ability for work*
59	A. B.	56	M.	Olecranon with trauma to skin	Wiring after healing	Painter	Limitation of elbow movements	B.	Able for light work
60	D. M.	18	M.	Olecranon	Wiring after healing	Butcher	None	G.	Working
61	W. C.	15	M.	Clavicle	Sling and early movement	Schoolboy	None	G.	Working
62	H. H.	52	F.	Patella	Wiring	Housewife	None	G.	Working
63	J. G.	47	M.	Patella	Wiring	Laborer	None	G.	Working

Good 4 Bad 1 = 5.

TABLE 8

SUMMARY

Fracture	*Died*	*Untraced*	*Good*	*Moderate*	*Bad*	*Total*	*Compound*	*Operation other than debridement*
Femoral neck		2	4	2	3	11	0	0
Femoral shaft	1		3	2	1	7	0	4
Humerus			5	2	1	8	3	0
Forearm			3	3	0	6	4	3
Ankle joint	1	1	9	2	1	14	2	0
Leg bones			8	3	1	12	2	0
Miscellaneous			4	0	1	5	0	4
	2	3	36	14	8	63	11	11
Out of 60 cases traced			60%	23.3%	13.3%			

FIG. 34

Case 43. Transverse fracture of fibula. Reduction and plaster. No disability.

FIG. 35

Case 44. Compound fracture, calcaneus. Excision of wounds. Box splint. No disability now.

were fractures. One case in every six seems a greater number of fractures than one would have expected. During the reviewed period it happened that the wards admitted emergencies every Saturday and it is an undoubted act that more accident cases are admitted that day than on any other in the week. This may account to some extent for the apparently large percentage.

Two patients died—a mortality of three and three-tenths per cent. —and in neither case was the death due entirely to the fracture under review. The one, a case of fracture of the femur, died as the result of a head injury and the other from a bronchopneumonia after discharge from the hospital. It is particularly gratifying to have only one death in eighteen cases of fracture of the femur. Ashhurst and Crossan report thirteen deaths in a series of 101 cases of fracture of the femur—a twelve per cent. mortality.

FIG. 36

Case 51. Compound fracture, tibia and fibula. Excision of wounds, reduction and box splint. No disability.

Sixty per cent. of the total number of traced cases were classed as good results; twenty-three and three-tenths per cent. as moderate; and thirteen and three-tenths per cent. as bad. This is not very different from Ashhurst's[1] figures on femurs—sixty-three per cent. good; thirty per cent. moderate; and seven per cent. bad; nor yet from Estes'[15] figures,—sixty-one per cent. good; twenty-seven per cent. moderate; and twelve per cent. bad. There are, however, no figures that are exactly comparable with those in this review.

It is interesting to note that no

fewer than twenty-two cases were operated on in the series. Eleven of these were for the purpose of sterilizing a compound fracture, while eleven were operated on with a view to producing and maintaining an accurate reduction of the fragments. In no case was it necessary to operate with a view to securing bony union, all the cases uniting without undue delay.

In making this compilation of fracture figures, it was expected that two questions at least would be answered by it. Are the results of fracture treatment really tragic? Can these results be improved in any way?

It is a striking fact that four cases out of ten are left with some degree of permanent disablement and no doubt there is an element of tragedy about this, but in estimating the end results one must also take into consideration the primary condition. In thirty-two of the cases the fracture implicated a joint, in eleven of them the fracture was compound, and in two of the humerus cases there was a dislocation complicating the fracture. It will thus be seen that the cases were of a fairly severe degree,—what one might term major fractures. It is evident, therefore, that the end results are fairly good, but this only makes one keener to see them better. One feels that there are few fractures that should be placed in the "bad" category if modern methods are used scientifically, always granted that the cases are admitted within a few hours of the accident. It is manifestly impossible to get a good result in a comminuted fractured elbow if the case is admitted days after the original injury, and particularly if ill advised attempts have already been made to reduce it. The first lesson to be taught, then, by such a compilation as this is that the earlier an attempt is made to reduce the deformity of a fracture, the greater the chance of getting accurate apposition of the fragments and, other circumstances being equal, the better the anatomical position, the better the functional result.

The patient with a fracture should, therefore, be considered just as

FIG. 37

Case 52. Comminuted fracture, head of tibia. Reduction and plaster. No disability.

FIG. 38

Case 53. Oblique fracture of tibia. Reduction and plaster. No disability.

imperatively in need of treatment as the one with an acute abdomen, and if comfortable even with the deformity, this should not be considered an indication to delay the initiation of treatment. In most cases it is of the utmost importance to have a two-view radiogram of the fracture prior to reduction. This is especially important in shaft fractures where damage may be done to soft tissues with an oblique fracture which would be reduced to a minimum were there a good x-ray available. Every surgical hospital should have a complete set of splints at hand. With modern ideas on the use of plaster-of-Paris this list has been reduced to very moderate dimensions, but nevertheless no hospital should be in the position of admitting a fracture case and, having admitted it, not be in the position to institute immediately the best treatment possible for that type of fracture. Included in such a list of splints one should have a Balkan frame or a Morison bed frame, and the means of applying extensions such as Finiochietto caliper, ice-tong caliper, etc.

When the fracture has been reduced and immobilized, the most careful daily supervision should be instituted. It should be frequently x-rayed

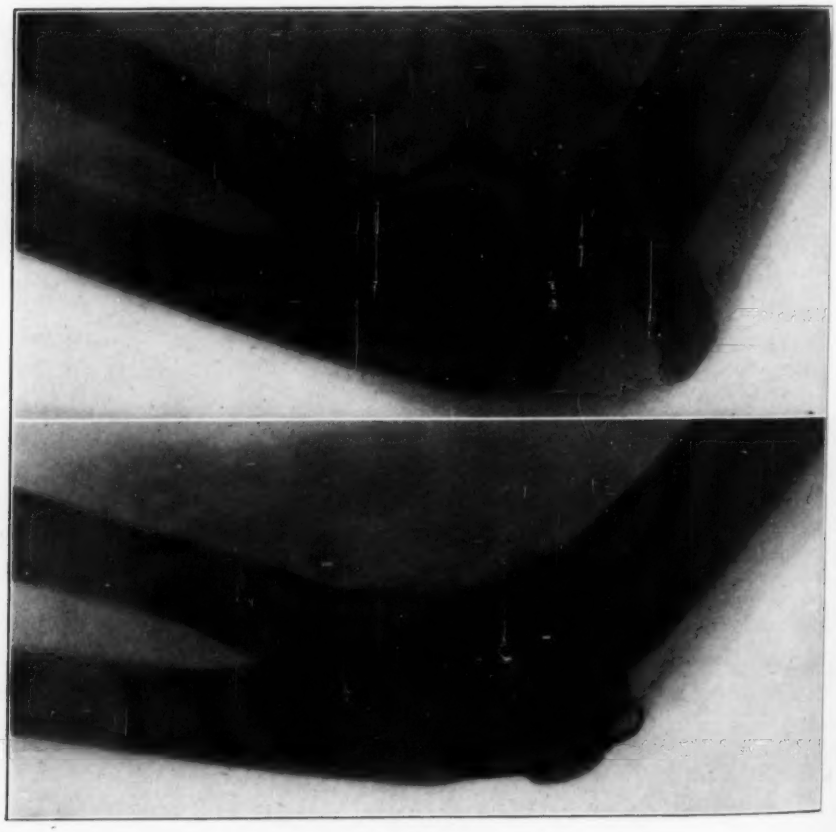

FIG. 39

Case 60. Olecranon. Wired, resulting in perfect function.

and measured, and attempts should be made to correct any deviation from the best possible position.

Carefully supervised physiotherapeutic treatment by a properly trained masseuse is of almost as much importance as the retention of the reduced fracture. At the earliest possible moment active movement and massage are instituted and attention is paid to every joint of the damaged limb.

Weight-bearing in the case of fractures of the lower limb should be advised only after careful consideration of the state of the callus and, when ordered, it should be started only by degrees and in the early stages always aided by some such splint as a walking caliper.

To know how your patients recover is to know if your methods are good; and so, lastly, the most carefully compiled reports should be made of all the various data in connection with the treatment of a fracture and, when the patient is discharged from the ward, he should be seen regularly and his progress reported on.

The author wishes to thank Prof. John Fraser for the privilege of being allowed the care of the cases and for his never failing kindnesses and help in every direction.

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AN IMPROVED ORTHOPAEDIC BED*

BY S. S. HANFLIG, M.D., NEW YORK

From Department of Surgery, Yale University, School of Medicine

An endeavor was made to design a bed that would obviate the difficulties encountered in the bed care of our orthopaedic patients. We had been using the usual hospital bed with Balkan frame attached and Bradford frame suspended from the Balkan frame.

The objections to this type of care are these: Raising the Bradford frame for bed changes by means of the pulleys is upsetting to the patient. It carries with it a risk of injury because of its instability; in fractures of the femur it definitely alters the angle between the femur and the pelvis, and at times is responsible for a shifting in the position of the fragments. The complaints of a patient that the lacing of his Bradford frame hurts, that it is either too wide or too narrow, or that the bedpan opening is not in the correct position, are too frequently heard. The use of shock blocks for elevation of the foot of the bed makes moving of the bed in the elevated position impossible without dropping the bed to its wheels. These and many other objectionable features have stimulated the design of the bed herein described. Its mechanism will be best understood by a study of the illustrations.

Figures 1 and 2 demonstrate its most salient feature. The Bradford frame is no longer suspended. It fits into notched openings at the ends of the bed. By a gear arrangement with a crank at the foot of the bed, the spring, with its mattress on it, can be lowered or elevated to the Bradford frame. The spring is really not a spring but a flat metal sheet with many circular openings designed to give firmness with some flexibility. The advantages of such an arrangement are many and obvious. The spring and mattress can be lifted snugly under the Bradford frame, giving the patient the benefit of its soft support.

The same two figures demonstrate another feature. The Bradford frame is no longer a Bradford frame. It can be narrowed or widened to any size to make the individual patient comfortable. It consists of two long bars which slide with adjustable stops across two shorter cross-bars. Two pieces of canvas are attached to these long bars. By turning the long bar which has a rotating ratchet device on its end the canvas can be made tight at any width of the frame. By shifting the location of the two canvas pieces the location of the opening between them can be adapted to meet the variations met with in different patients. The ratchet device

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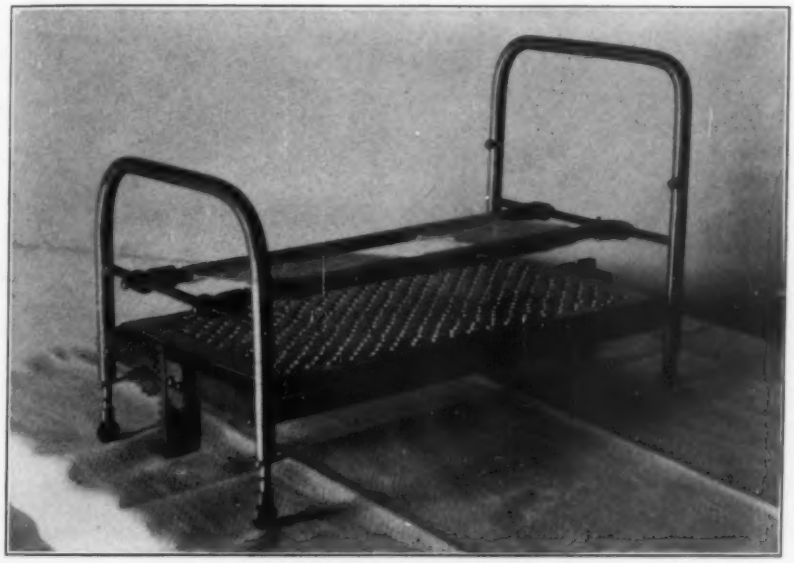

FIG. 1

Bed with spring lowered, Bradford frame attached, and foot of bed elevated.

FIG. 2

Spring raised to meet Bradford frame; Bradford frame widened; pillow rest applied.

FIG. 3

Bed in position for occupancy—mattress and spring raised; foot of bed elevated; pillow rest applied.

FIG. 4

Bed with Bradford frame removed for use as ordinary bed.

mentioned above can be seen in the illustration at the head of bed. It is wound by inserting a short rod in a small hole at the end of the long bar. It is planned to make the long bars of aluminum, so as to prevent the interference with good x-ray pictures, so often encountered in the iron Bradford frame. The entire frame with the patient on it can be removed as a unit. Figure 4 shows the bed with the frame removed.

For raising the head or foot of the bed we have made our wheels with long shackles. They slide up and down in the bed posts. By the insertion of pins any desired elevation may be maintained and the bed may be wheeled about without changing that elevation.

For raising the patient's pillow and head, a light aluminum pillow rest was designed. It hangs on two pins at the head of the bed, and can be removed merely by lifting it upwards.

Figure 3 shows the bed assembled as an orthopaedic bed. Figure 4 shows its possibilities as an ordinary bed. The author believes that such a bed has a place in the efficient care of orthopaedic patients.

A device is being designed which, when attached at either end of the bed, will give suspension and countertraction for the various types of splints used. It is hoped that it will make unnecessary the use of the cumbersome Balkan frame.

FIFTY CASES OF BURSITIS OF THE FOOT*

BY PERCY WILLARD ROBERTS, M.D., NEW YORK

The fifty cases of bursitis of the foot upon which this paper is based were collected after the attention of the writer was called, a little more than a year ago, to an article by Arthur E. Hertzler of Halstead, Kansas, entitled "Bursitides of the Plantar Surface of the Foot". In reviewing this material the writer was impressed with the fact that there were twenty-two cases of the series previously treated for periods varying from a few months to five years under mistaken diagnoses of weak foot, metatarsalgia, or calcaneal spur, in which relief of symptoms promptly followed the employment of such procedures as are customarily adopted to control inflammation of bursae. From this record, confirmed by personal inquiries, it is evident that many orthopaedic surgeons are unfamiliar with the fact that bursitis in certain areas may produce symptoms which simulate those of weak foot, metatarsalgia, calcaneal spur, fracture of a sesamoid under the head of the first metatarsal, or arthritis of the ankle.

There are two reasons for this lack of diagnostic discrimination. In the first place American and English text-books on anatomy describe only a few of the many constant bursae in the foot and ankle and make no reference whatever to the occurrence of adventitious formations commonly found in a variety of situations. Unaware of the presence of these numerous bursae, the older surgeons naturally sought other reasons than bursitis to explain various types of foot pain. Thus was laid the foundation for the second factor in our errors of diagnosis. The earlier students of the causes of foot disability arrived at the very plausible conclusion that foot pain is the result of static strain or structural deformity, and this satisfying theory has become universally accepted. Upon it have been based all methods of treatment. There can be no argument that the theory is in the main correct, but as it disregards the presence of very numerous bursae it omits a potential cause for painful disabilities which cannot be wholly overcome by correcting static strain or structural deformity.

The purpose of this paper is to call attention to this additional cause of foot pain which has been wholly ignored in the literature except for the contributions of Hertzler. This series of cases has afforded abundant proof that bursitis is a disabling condition of common occurrence, well worth consideration in some detail, which may be advantageously discussed under separate headings. First, however, attention should be

*The author's first contribution on this subject appeared in the American Journal of Surgery, (VI, 313) March, 1929, and was prompted by an article by Arthur E. Hertzler of Halstead, Kansas, appearing in the same journal in 1926. During a further study of bursitis of the foot, fifty cases were collected which form the basis of this paper.

called to the substance of a description of a bursa given by Clarkson, the English histologist, which will explain the frequent development of adventitious structures of this nature in unwonted places. He says a bursa is nothing more than an enormously distended lymph space, the cells of the connective tissue walls of which have, as a result of constant friction, assumed the function of secreting a fluid more viscous than lymph to act as an antifriction medium between two surfaces gliding upon each other. From this it will be recognized that bursae of various sizes may appear in areolar tissue anywhere in the body; and that the foot, because of its numerous moving parts compactly bound together and because of the stresses and strains to which they are subjected, is a fertile field in which bursae may develop. Admitting that these sacs are commonly found in the foot and knowing the disabling effects of bursitis in other situations, we have a reasonable explanation for the resistance of certain disabilities to our most painstaking efforts to overcome them by the restoration of static balance or the correction of structural deformity.

FIG. 1

Bursae interposed between the metatarsophalangeal joints (Spalterholtz).

ANATOMY

In addition to the bursae under the os calcis, at the lower extremity of the tendo Achillis, and over the metatarsophalangeal joint of the great toe, described by English and American anatomists, Spalterholtz adds those overlying the capsules of the metatarsophalangeal joints of all the toes (Fig. 1). Hertzler has called attention to a constant bursa between the flexor tendons and the head of the abductor hallucis, and those lying under the tendons of the lumbricales (Figs. 1 and 2). Careful dissection of the foot will reveal a large pocket between the flexor brevis digitorum

and the flexor accessorius (Fig. 2), and a small sac under the tendon of the tibialis longus near its insertion into the medial cuneiform. Common sites for the formation of adventitious bursae are in the fat pads anterior to the tips of both malleoli, between the tendon of the flexor brevis digitorum and the first metatarsal just posterior to the sesamoids, on the outer surfaces of both the heads and bases of the fifth metatarsals, and in the superficial fascia of the plantar surface of the foot (Figs. 3, 4, and 5).

OPERATIVE FINDINGS

The findings at operation in the twenty-five cases so treated were of varied character. In some instances the bursal walls were thick and tough, and the sacs reached a diameter of an inch and a half. In others the structure of the bursa was of extreme delicacy, and in still others no definite sac could be demonstrated. The thick-walled bursae, as might be expected, were found where the structures were subjected to more or less constant pressure. This type was most frequently seen under the tuberosity of the os calcis and also on the lateral side of the head of the fifth metatarsal. The pocket between the flexor accessorius and the flexor brevis digitorum, although large, was consistently thin-walled. The metatarsal bursae were delicate sacs of various sizes whose walls were easily destroyed by a curet. The premalleolar bursae seldom were demonstrable at operation, but on two occasions definite sacs about half an inch in diameter were found in the center of the fat pad which in all cases was excised in its entirety. The bursa lying between the head of the abductor hallucis and the tendons of the long flexors was always well defined and always thin-walled. It did not connect with the tendon sheath. The subcalcaneal bursae were not always accompanied by exostoses on the bones, although clinically there was no difference in the pain element between those cases in which spurs were present and those in which no exostoses existed. The author agrees with Hertzler that in "painful heel" the bursa is more often at fault than the spur. Certain it is that if in operations for removal of spurs the bursae are not destroyed,

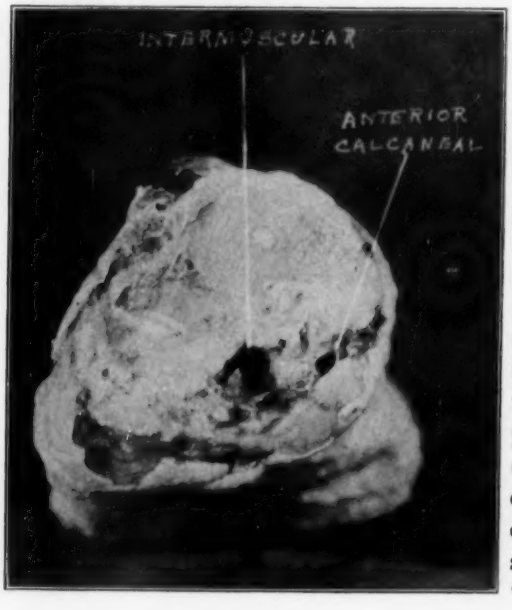

FIG. 2

Specimen showing location of large bursa between the flexor digitorum brevis and the flexor accessorius, and that between the head of the abductor hallucis and the long flexor tendons.

symptoms are apt to recur, whereas relief may be afforded by obliteration of the bursa without touching the spur. This was strikingly illustrated in the case shown in Figure 7. A large, thick-walled bursa, containing a very considerable amount of fluid, was dissected from the under surface of the heel and the spur left intact. When examined two months after operation there had been no return of pain although the patient was on his feet eight hours a day. The spurs, as will be seen were unusually large.

The size of the bursa does not always correspond with the degree of pain. In one case of bilateral bursitis of the sole where the patient did not complain of one foot more than the other, a bursa about a half-inch in diameter was dissected out of the superficial fascia of the sole on one foot and on the other no sac was demonstrated. Excision of a portion of the fat pad corresponding to the area of tenderness found on pre-operative examination of the latter foot, relieved the acute symptoms which had persisted for six months. This finding, confirmed by similar experiences in other areas of the foot, would indicate that not the size of the bursa, but the resistance and degree of distension of its walls, determines the severity of the symptoms. Bearing in mind Clarkson's description of the origin of bursae, it is obvious that minute structures in which repeated trauma has caused inflammation, may produce pain out of all proportion to their size.

FIG. 3

Common sites for adventitious bursae on the outer side of the foot.

FIG. 4

Bursae of the dorsum of the foot. Solid lines indicate constant bursae. Broken lines show location of adventitious sacs frequently found.

SYMPTOMS

There are few minor ailments more disabling than a bursitis wherever it may occur, a fact illustrated by the common bunion, the "tennis elbow", and the helpless shoulder of a subdeltoid bursitis. In the foot it may produce symptoms more far-reaching than the cause of the trouble would suggest, as the discomfort is not confined to the area of the affected bursa. Pain, sometimes sharp, sometimes aching in character, may extend a considerable distance from its source and simulate the discomfort of longitudinal arch strain, depression of the metatarsal heads, fracture of a sesamoid, or even arthritis of the ankle.

Inflammation of the metatarsal bursae produces what is ordinarily termed metatarsalgia,—a condition that has heretofore been ascribed to a variety of causes, none of which were entirely satisfactory. Bursitis in this region gives rise to a disabling soreness sometimes confined to the ball of the foot, sometimes extending upward and backward, and sometimes accompanied by puffiness of the adjacent soft tissues. The pain subsides when the foot is at rest and recurs when standing or walking is resumed. Acute twinges of pain occur in stepping on an uneven surface because sudden pressure is brought upon the distended sacs.

When bursitis occurs in the areolar tissue in front of the malleoli, a not uncommon condition, the symptoms are similar to those of arthritis of the ankle. Patients complain of generalized pain in the region of the joint on walking. Examination will reveal an acutely sensitive, sharply defined area in front of and below one or both malleoli and

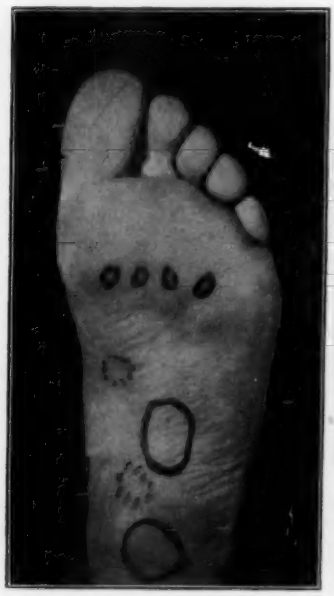

FIG. 5

Showing location of the subcalcaneal, intermuscular and metatarsal bursae, and of those found in the superficial fascia of the sole.

FIG. 6

Medial view of foot showing location of permanent and adventitious bursae.

no evidence of joint involvement whatever. Excision of the affected fat pad results in a permanent cure and, incidentally, confirms the diagnosis.

Inflammation of the bursa under the head of the abductor hallucis muscle or of that between the flexor digitorum brevis and the flexor accessorius produces symptoms very similar to those of painful weak foot and may easily be mistaken for this condition if examination is carelessly performed. It is in cases of this type that the routine prescription of foot plates for the relief of arch discomfort is apt to result in disappointment. One of the author's patients who had during a period of two years seen several orthopaedic surgeons and acquired a useless collection of foot plates, was completely relieved by ten days' rest in bed with wet dressings and a compression strapping continuously applied.

When bursitis develops between the tendon of the flexor brevis hallucis and the metatarsal bone, the disability is extremely suggestive of a fracture of the sesamoid. The differential diagnosis rests clinically upon the location of the point of tenderness, which, in the case of bursitis, is at the posterior or anterior margin of the bone instead of over it as is the case in fracture.

Concomitant symptoms of bursitis of the foot are leg weariness and stiffness of gait due to involuntary efforts to prevent pain caused by normal use of the foot. In three cases this resulted in a loss of general well-being and a moderate grade of mental depression because the patients were obliged to give up their usual business and recreational activities.

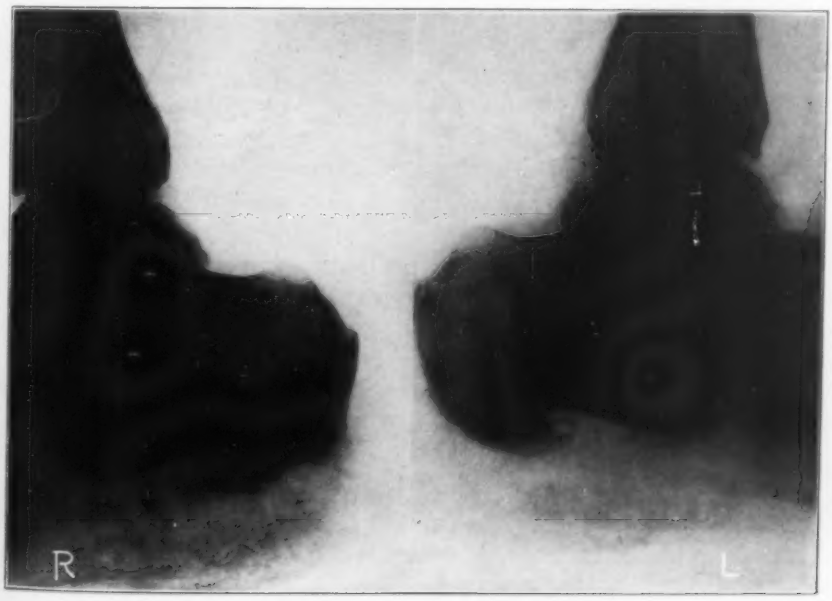

FIG. 7

Postoperative radiograph of an extreme case of "painful heel" entirely relieved by excision of bursae without removing exostoses on os calcis.

EXAMINATION

From observations made on the fifty cases of this series the writer is convinced that no examination of a painful foot is complete unless careful search is made for the presence of a bursitis. Circumscribed tender areas not due to trauma or infection are suggestive of inflamed bursae. The pain caused by pressure on a sensitive bursa cannot well be mistaken. It is acute and the area of tenderness is definitely limited, although the patient's description of the existing disability may have referred to a general aching and discomfort in the area surrounding the point of tenderness. If the metatarsal bursae are involved, lateral compression of the anterior part of the foot will frequently cause pain, and so will hyperflexion of the toes which causes pressure on the bursae through tension of the overlying soft parts. In examining the sole of the foot, the location of the affected bursa may be determined by the degree of pressure required to elicit pain. Moderate pressure will cause pain if the bursitis is in the superficial fascia and rather deep pressure will be required to elicit a reaction in the bursae anterior to the tuberosity of the os calcis. The diagnosis of premalleolar bursitis as a cause of discomfort in the region of the ankle will rest upon the discovery of an acutely sensitive point in the areolar tissue in front of the tip of the malleolus. Passive motion of the ankle or pressure over the transverse interarticular space causes no discomfort. In other parts of the foot, as elsewhere in the body, circumscribed areas of acute tenderness, not due to trauma or infection, may safely be considered as indicating a bursitis.

TREATMENT

The treatment of bursitis of the foot differs in no essential from the treatment of bursitis elsewhere. The problem is to protect the distended sac from pressure or to obliterate it surgically. In many cases the symptoms will disappear if the part is put at rest and wet dressings are applied for a week or ten days. Rest in this instance means complete rest in bed. Intermittent relief from weight-bearing is not sufficient. Adhesive plaster strapping applied with a view of preventing friction is frequently helpful in moderate cases but will prove disappointing if the condition has existed for some time and the symptoms are acute. When conservative measures fail, surgical obliteration of the affected bursae is indicated. This can often be done through a small incision which will permit the vigorous use of a sharp curet, except in cases of premalleolar bursitis where it is better to dissect out the entire fat pad and let the skin collapse over the fibrous expansions covering the joint. Two weeks will be required for convalescence. In the twenty-five cases operated upon, there have been no recurrences, although two were slow in making a complete recovery. Of the fifty cases, twenty-five were treated conservatively, twenty-five were operated upon, forty-one were relieved, nine were improved, and none were complete failures. Summarized, the treatment and results of the cases in this series were as follows:

Type	Number	Conservative Treatment	Operated	Relieved	Improved
Metatarsal	26	14	12	20	6
Plantar	16	8	8	14	2
Premalleolar	8	3	5	7	1

FUSION OF THE RADIO–ULNAR JOINT

BY C. H. BALDWIN, M.D., UTICA, N. Y.

The accompanying x-rays present an unusual anomaly,—complete fusion of the radio-ulnar joint associated with normal growth of the radius and ulna. The humero-ulnar joint is normal in every respect.

A boy of four was presented for examination because he used the right arm and hand somewhat clumsily. Birth had been normal and no history of injury could be obtained. Parents had noticed that from early infancy he had not used the right arm as he did the left.

No difference in the size or contour of the arms was present. The right forearm was held in a position midway between pronation and supination. All endeavors to rotate the forearm were accomplished by rotation of the arm as a whole, forearm rotation being entirely absent. Extension and flexion of the elbow were normal.

FIG. 1

FIG. 2

It is difficult to say whether this is a congenital anomaly or whether at birth there was an injury of the radio-ulnar joint. In the lateral view, the radius occupies practically its normal position. It is extremely difficult to produce an artificial fusion in an infant's joint. Development of the joint as a whole has proceeded along normal lines. That it is a congenital fusion is the more tenable supposition.

BONE ABSCESS IN APOPHYSIS OF OS CALCIS*

A Clinical Report

BY DENIS S. O'CONNOR, M.D., NEW HAVEN, CONN.

The term "bone abscess" has been chosen to designate the condition here reported because of the clearness of the term and its applicability to the case.

J. R., student, ten years old, was referred to the writer on January 30, 1928, with the complaint of pain in left heel and leg.

About three months previously, while at play, a large stone struck him on the left heel. The injury was not sufficient to distract him from play and was not positively painful. The following morning on arising, the region about the heel was distinctly sore but not disabling. About one week later the heel became swollen and painful. The family physician was called and prescribed rest in bed and an ice bag to the heel. The child was in bed for four weeks and was then permitted to get around, but continued to limp slightly. Two days before being referred to the author, after a long walk, he had a sharp pain in heel and leg which continued.

Examination showed a moderately developed and nourished boy apparently not acutely ill, but walking with a distinct limp. General examination negative except for left heel.

Moderate diffuse enlargement about posterior aspect of left heel. Slight redness and increased local heat. Inversion and eversion of foot slightly painful. Walking

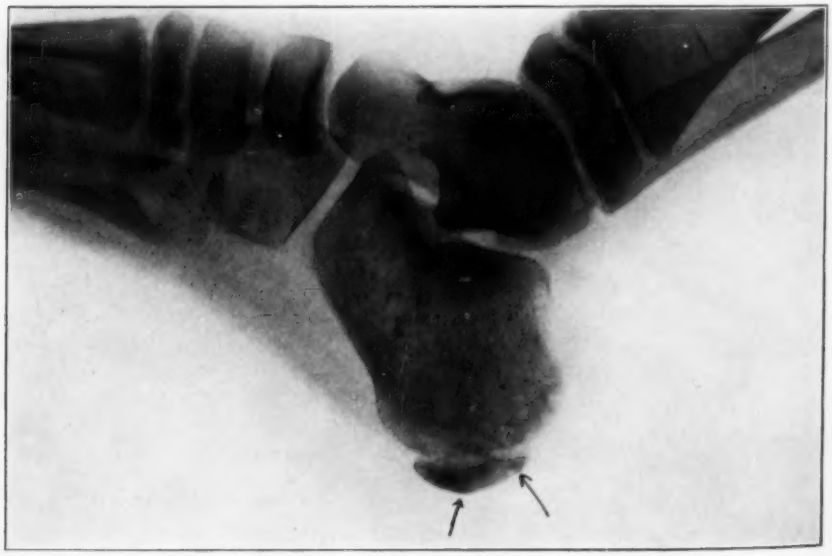

FIG. 1

Lateral view of apophysis of os calcis before operation, showing area of rarefaction in the bone.

*From Department of Surgery, Yale University School of Medicine.

FIG. 2

Anteroposterior view of os calcis, showing extent of rarefaction in apophysis before operation.

FIG. 3

Anteroposterior view of os calcis, showing area of rarefaction in apophysis two months after operation. The apparent difference in point of involvement of the os calcis as shown in this picture is due to the transposition of the negative in printing.

FIG. 4

Anteroposterior view of the os calcis one year after operation, showing area of involvement in the apophysis at that time.

on uneven ground painful. Patient able to rise on ball of left foot, but this was slightly painful. Definite localized tenderness on pressure over the posterior aspect of the os calcis. General temperature slightly elevated.

Roentgenograms (Figs. 1 and 2) show localized area of rarefaction in the apophysis of left os calcis. Von Pirquet tuberculin test negative.

February 20, 1928—Transverse incision on posterior superior aspect of heel. Flap turned down, exposing posterior surface of os calcis. Vertical incision made through periosteum and latter reflected from bone. Periosteum showed typical reaction of acute inflammation of moderate degree. Bone removed from area shown by x-ray to be diseased, and culture taken. No definitely recognized pus seen, but cavity was lined with granulation tissue which was removed. The wound was closed with a small drain down to bone cavity. A few days after operation drainage became purulent.

March 14, 1928—Wound completely healed. Culture taken from cavity at operation showed staphylococcus aureus.

March 21, 1928—Tenderness gone.

April 14, 1928—Roentgenogram (Fig. 3) shows definite decrease in size of cavity. Patient free from pain and tenderness, but activity restricted as a precautionary measure.

December 16, 1928—Patient has been completely free from symptoms since recovery from operation. Heel normal in appearance.

January 20, 1929—Roentgenogram (Fig. 4) shows definite decrease in area of rarefaction.

ELBOW DISLOCATION AND ULNAR NERVE INJURY

BY F. J. COTTON, F.A.C.S., BOSTON

Boston City Hospital

Save for a previous note of the writer,* no one seems to have noted this curious little group of cases.

In children from nine to fourteen years of age, dislocation at the elbow is not seldom accompanied by a tearing off of the isolated epiphysis of the internal epicondyle. In reduction of the dislocation this fragment may be reduced *into* the joint.

It is difficult to explain just how it happens;—all the cases seen by the author have been reduced by some one else. They have come to him two or four weeks later, with a joint far stiffer than should be with a youngster who has had an elbow luxation properly reduced, and they show an associated ulnar nerve lesion.

The writer has seen ten cases,—each almost matching the others; and gives three of the ten here,—the recent ones.

The ulnar lesion is never complete, but shows both sensory and motor loss. Diagnosis is *confirmed* by the x-ray.

Treatment is operative only,—incision along the inner side of the elbow, careful exposure and freeing of the nerve, and removal of the now superfluous epicondylar epiphysis from its bed between ulnar and trochlear surfaces. It may as well be removed, and the capsule and muscle origins can be caught together with a stitch.

One finds the nerve pulled on—with a cross pull—by fibrous tissue bands—rags of fibrous tissue—running from the errant epicondyle back to the bony seat from which it was displaced.

In most of the cases the nerve has been swung to a position forward† and imbedded in the adjacent fat of the joint; but this is in no way necessary, if it is efficiently freed from tension.

*The first case seen was nearly twenty years ago, a son of Dr. F. B. L., successfully operated on later by the late Dr. Edward H. Nichols. The note was in the writer's book—Dislocations and Joint Fractures: Philadelphia, W. B. Saunders Co., 1910.

†The same method has been used in the cases reported by the writer of *late* ulnar nerve damage from adhesion to (and consequent traction on) the ulnar nerve, in all sorts of elbow fractures—even in ulnar contusions. Dean Lewis's cases have been, usually, cubitus varus cases with old external condyle fracture (ununited): while the writer's have been (with some of his sort) predominantly fractures or mere contusions involving the *inner* side of the elbow *directly*.

In these cases the ulnar nerve often shows very *late* involvement, and from intermittent traction on an adherent nerve as a rule, often without any compression. In the cases treated in this paper damage was from direct compression, and immediate.

In no case has there been *gross* damage of the nerve.

In some cases recovery has been prompt, in others tardy, a matter seemingly dependent not so much on the grade of trauma as on the number of weeks the lesion has gone undiagnosed.

It is a small class of cases, easily recognized and relieved, if one happens to know the picture. It is a bit surprising, however, that in every one of the author's cases from the first seen nearly twenty years ago, to these published three, the actual condition has uniformly been overlooked for weeks.

The only excuse for confusion is in misreading the x-ray, and supposing (as a very fair radiologist supposed in Case 2), that the fragment in the joint is from the capitellum.

Absence of the internal epicondyle from its proper place is conclusive enough. Add to this the nerve lesion and there can be no question.

The errors, in fact, seem to be from satisfaction over getting the dislocation reduced, and omission of any detailed examination afterward.

The chance of this particular lesion should be remembered in treating every elbow dislocation occurring in childhood.

CASE 1. H. W. of Hyannis, Mass. Patient of Dr. Beale of Sandwich, Mass. Case three weeks old. A girl of thirteen. Backward luxation of the elbow reduced by Dr. George H. Gray, of Hyannis, a very competent surgeon. He reported limited motion, pain, partial lesion of ulnar nerve with both sensory and motor disturbance. Diagnosis obvious; operation advised.

The child was sent up to Boston and on examination showed the typical picture; elbow with an evident mechanical hindrance to both flexion and extension, and partial, though extensive, loss of both motor and sensory function of the ulnar nerve. The x-ray was typical (See Figure 1). Operation was advised, and performed at the New England Hospital for Women and Children, June 7, 1927.

Operation: Usual incision, postero-internal aspect of elbow, about five inches in length. Findings typical: the *epicondyle missing from its normal site,*—no normal anatomy there, but a mass of fibrous tissue. Ulnar nerve identified above the joint, and followed down; found held by a band of fibrous tissue leading into the joint. Joint gently pried open, and the internal epicondyle pulled out from where it had been snuggling between trochlear and ulnar surfaces. This cleared the nerve of tension. The nerve trunk showed no gross damage. Epiphysis was shelled out of its bed of fibrous tissue and thrown away; the tissue laid down and sutured in place, the nerve carried in front of the joint, and laid (and held) in a bed of rolled-up fat. A stitch was taken to approximate torn capsule, a subcutaneous tension stitch, skin stitches and a compression dressing in extension.

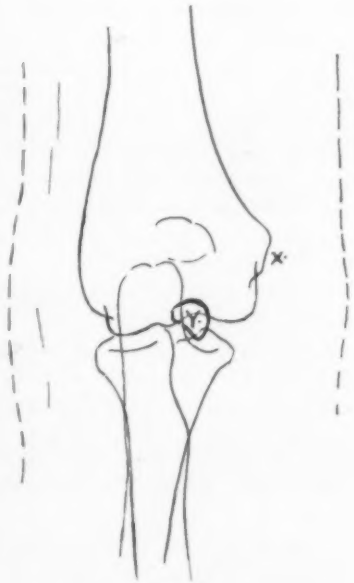

FIG. 1

Case 1. Tracing from x-ray preperative.

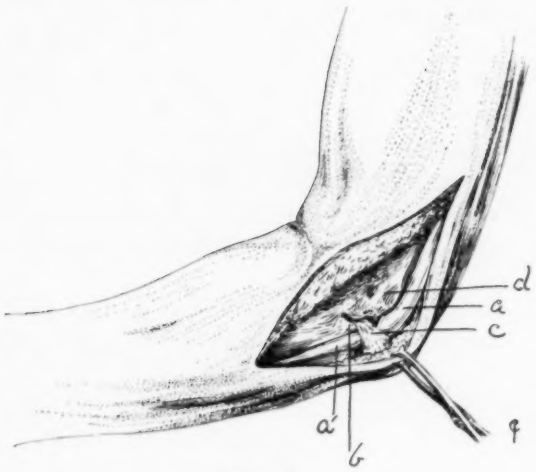

FIG. 2

Case 2, J. H., operative findings.
a, a'. Ulnar nerve.
b. Edge of ulnar joint surface.
c. Fibrous band, connected with the displaced (invisible) epiphysis, and compressing the ulnar nerve.
d. Bed on the humerus from which the epiphysis had been torn.
The epiphysis is *within* the joint.

Immediate convalescence was uneventful.

Seen again on July 5, 1927. Then showed a little improvement in sensation, no definite gain in motor function. Elbow without joint reaction: motion from 80 degrees in flexion to over 125 degrees in extension.

Improvement in this case slow, and when last heard from (summer of 1928) was reported by her physician as being "all right" but with a trace of residual numbness and not quite full motion at the joint.

CASE 2. J. H., aged ten. Admitted to the Boston City Hospital, June 25, 1927.

Diagnosis: Fracture internal condyle; ulnar palsy; right.

June 1, 1927, patient jumped a fence, and fell on the right hand. Elbow dislocated backward; reduced by the family doctor in due course, but pain and partial anaesthesia and poor motion were manifest shortly afterward.

Seen in the Out-patient Department, in the Friday Bone and Joint Clinic, and sent into the "House". Almost complete ulnar anaesthesia, and much motor loss as well. X-ray shows the fragment of condyle (the epiphysis) within the joint.

Operation, by the author, June 27, 1927: Incision on ulnar side,—length four inches. Nerve exposed: found bound down by fibrous band from condyle to the separate fragment lying inside the joint, the attached fibrous bands obviously choking the nerve. Rent in capsule was enlarged, and the fragment removed. Nerve freed, carried forward to a new bed in front of joint and so held by enclosing sutures. Usual closure. Pressure dressing.

July 1, 1927. Clean. Patient restless. Discharged. Given exercises and gradual use of arm.

July 7, 1927. Examination: Slight improvement in sensation. A little power of spreading the fingers and abducting the thumb. Elbow motion from beyond right angle in flexion to twenty degrees of extension. To wear sling only.

September 16, 1927. Now sixty degrees of extension. Sensation still a little dull over whole area, but present. No trophic changes. Thenar muscles pretty good; can adduct the thumb and spread the fingers. Hypothenar muscles not evidently atrophied at all.

April 4, 1928. Neurological examination (Dr. Wolff) shows no atrophy or loss of motor function, but slightly diminished sensation.

Examination October 11, 1928, shows sensation still a bit dull over ulnar area, but function of muscles perfect, mobility of elbow complete save for ten degrees loss of extension.

Case 3 came to the attention of the writer after the foregoing part of the paper was written.

The case is different only in that displacement and lesion were more extreme, the nerve not only caught up by bands as the internal epicondyle travelled into the joint, but actually joining in its unfortunate excursion:—in this case the nerve was not only compressed and carried toward the joint by the fibrous bands, but had actually been carried *into* the joint and there pinched between the bones.

It is the only case seen that presented either the imperfect reduction or the actual pinching of the nerve *within* the joint.

Case 3. R. H., male, aged ten, was seen on November 2, 1928, with a left elbow luxation alleged to have been reduced two and one-half weeks earlier. The joint was locked; there was an evident involvement of the ulnar nerve shown by partial anaesthesia. Apparently, motor loss also, but the general helplessness of the limb made this factor hard to evaluate.

The joint was locked, or near it, at about the right angle, the internal condyle not discoverable anywhere by palpation, and the cup-shaped end of the radius was palpable on the outer side of the elbow.

Obviously the dislocation had been reduced only incompletely and apparently the internal epicondyle, and the nerve with it, had been dragged into or to the edge of the joint.

In no other way may one explain nerve damage and joint-locking combined with absence of this epicondyle from its normal place.

The x-ray didn't help much, but did show an incomplete reduction, and what seemed to be (and later proved to be), the internal epicondylar epiphysis displaced outward *and forward* into the joint.

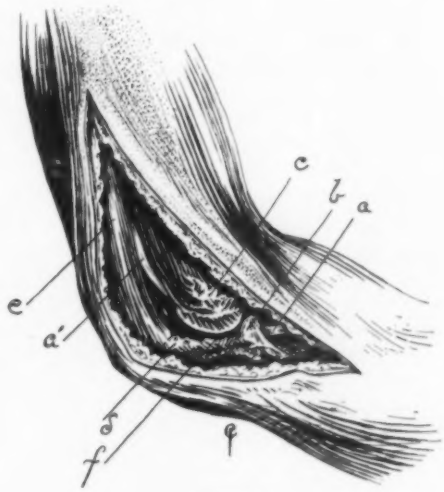

Fig. 3

Case 3, R. H. Operative findings.
a. Ulnar nerve below joint, and disappearing into its cavity.
a'. Ulnar nerve found above the joint, disappearing *into the joint*.
b. Fibrous band, connected with the epiphysis which had been reduced *into the joint*.
c. Bed on humerus from which the epiphysis was torn.
d. Edge of articular surface of olecranon.
e. Edge of triceps muscle.
f. Joint cavity, wedged open by the mass of displaced epiphysis, and displaced nerve *within* the cavity.

He was sent into the "House" and operated on November 5, 1928. A long incision on the inner aspect showed massive scattered old hemorrhages, and an astonishing amount of fresh repair tissue.

On exploration above the joint, the ulnar nerve was found, as usual, under the front edge of the triceps, and could be followed down to near the olecranon. There it disappeared into the joint. Sought below the joint it was found where it belonged, far down, and traced upward to the joint. Then a cautious cutting of old fibers and of new ligament repair rendered possible the opening up of the whole inner side of the joint, and the nerve, pressed between trochlea and olecranon to half its size, was swung out of the joint into full view.

The epicondyle, which had dragged it in, was searched for and was found, anterior to the humerus, firmly wedged in, still carrying ligamentous attachments and the origins of the inner flexor muscle group. The joint structures were stretched with the "joker" and a "skid", and the outward luxation then reduced. The epiphysis of the internal epicondyle was resected, sub-periosteally, the muscle insertions and their periosteal origins dragged in and up, and sutured to their normal place; the ulnar nerve was then carried forward of the joint, and imbedded in fat as best might be,—for the tissues were much infiltrated with old blood and new repair tissue. Then the capsule was caught together, and the wound closed with a "Western" pressure dressing of cotton-batting and bandage.

At the end, flexion was free, extension free to within twenty degrees, effective to within ten degrees under reasonable force.

The author has not seen just this thing before or heard of it. It is like the looped sciatic nerve in reduction of hip luxations. At all events, the case is cited as belonging, obviously, in the same docket with the other two, if not typical.

(CASE 3) *November 12, 1928.* "Shows no reaction, save slight uneven temperature, no pain; but he is as yet unable to move the fingers or thumb. Anaesthesia in ulnar area only very slight,—none in the rest of the hand." A tourniquet was used in this case (although in general the writer is inclined against them); though the operation fell well within the half-hour limit, there was some concern about the motor loss.

December 14, 1928. "Boy shows some motion in the fingers, but not much yet. Sensation has returned except in the ulnar region, which was to be expected. This arm should be gotten up to right angles with a cock-up splint. If somebody could take up the question of voluntary exercises with this boy it would be worth while. Obviously there is a functional element in this case."

The surgeon in the Out-patient Department flexed this arm under an anaesthetic, and the lad went back to the Physiotherapy Clinic.

Examined February 1, 1929. No paralyses left, but some muscle weakness. Motor function of muscles supplied by the ulnar nerve present, not too strong. Muscle bulk returning. On the sensory side only a partial anaesthesia of the little finger remains. Elbow function not yet good:—full flexion, but extension as yet only about twenty-five degrees.

The odd thing about these cases is that there must be a lot of them outside Massachusetts (and in Massachusetts) and no one seems to be concerned about them, nor has anyone seemingly seen the end result of a long neglected case.

NOTE: Since this paper was prepared, two further cases of this same condition have been seen by the author, but are too recent for a final result.

FOREIGN BODIES IN JOINTS

BY P. MOULONGUET, M.D., PARIS, FRANCE
Surgeon of the Hospitals of Paris

The foreign bodies in joints can be placed in two main groups,—those of synovial and those of osseous origin.

FOREIGN BODIES OF SYNOVIAL ORIGIN

These have before been called capsular foreign bodies, ecchondroses or arthrophytes. They occur in arthritis deformans and in the nerve arthropathies; but also in articulations apparently healthy, where the lesions of cartilage and synovia with chronic arthritis are very localized, and it is this anatomical type which presents the greater surgical interest. The osteocartilaginous foreign bodies are the important lesions of this kind, and their removal results in a complete cure.

The development of the synovial foreign bodies can be understood only by a knowledge of the lesions of the dry arthritis, which have been so well described by W. Hunter, Colles, Redfern, Cruveilher, P. Broca, etc. The description by Laennec of the mode of formation of the arthrophytes at the level of the hyperplastic synovial fringes, or at the periphery of the cartilage,

FIG. 1
A foreign body of synovial origin (after Morel Lavallée).

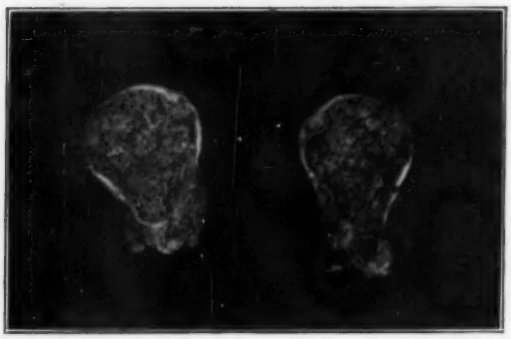

FIG. 2
Section of an arthrophyte.

is accurate. These arthrophytes are always pediculated at the beginning of their evolution; they appear as a form of a sub-synovial nodosity, slightly elevated and projecting into the cavity. Later they become free by the rupture of the pedicle, which has grown slender. These bodies are more or less numerous, roughly spherical, with at times a depression where the pedicle was inserted; the surface is rough and mulberry-form, and of pale yellow color (Fig. 1). It is at once recognized that often they have an osseous center, enclosed in a more or less thick capsule of cartilage. Sometimes the osseous center is lacking, and the body is entirely cartilaginous; in the periphery a thin, fibrous layer can be distinguished, lying on the synovial capsule, under which the arthrophyte is formed (Fig. 2).

The microscopic examination confirms the macroscopic, and it is possible to make a distinction between the pediculated and the free foreign body: in the first case the bone is alive and osteoblasts stain easily; in the second, the bone is entirely dead. This difference does not exist in the area of the cartilage, which remains living even in the free bodies,

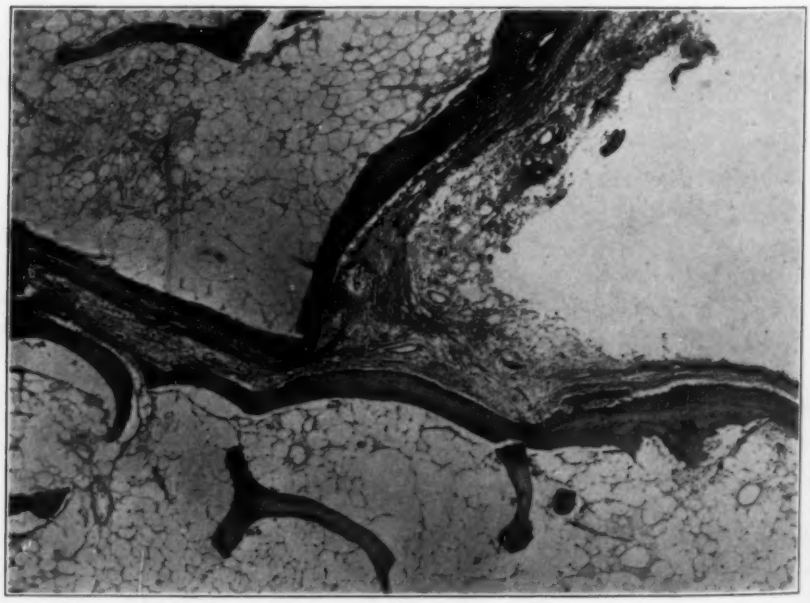

FIG. 3
Histological section of a pediculated arthrophyte.

for this is able to be nourished through the synovial fluid. It can be seen that in the foreign bodies of synovial origin, the bone is represented by a spongy tissue, with large scales, and that the cartilage or fibrocartilage is always formed from this degenerative capsule without the appearance of normal articular cartilage. That which characterizes histologically the foreign body of synovial origin is structure of the tissue, which does not at all suggest the origin from the articular extremity (Fig. 3).

The writer in collaboration with his colleague, P. Huet, has succeeded in producing in the rabbit pathological foreign bodies entirely comparable with those in the human subject, and this by two processes,—in the *serique* arthritides, and in the attempts to make nerve arthropathies. The *serique* arthritides are obtained by several injections of horse serum into the knee of the rabbit; in one case, for example, after eleven injections an arthrotomy was made after two months which showed a hyperplasia with considerable congestion of the synovial membrane. The swollen fringes were present as in the dry arthritis of adults (Fig. 4); in one of these fringes there was a small calcified area under this synovial membrane. In another experiment, in which there was lesion of the posterior horn of the spinal cord, associated with injury by wrenching the knee, there was found, several months afterwards, a pediculated foreign body formed by spongy

FIG. 4

Experimental *serique* arthritis in rabbit.

FIG. 5

Foreign body of synovial origin obtained by experiment.

bone, with cartilaginous islets absolutely identical with the foreign bodies in the human (Fig. 5).

It is unnecessary to dwell on the clinical history of the pathological foreign bodies; it is well known. It is necessary only to take note of the appearance by the radiogram. This kind of a foreign body appears alone, even when it is osseous; the shadow is mottled; even when the cartilage is well calcified; the shadow is homogeneous and thin.

The difficulty is to reconcile the anatomical evolution of these foreign bodies with their clinical signs. It is certain that the formation of these foreign bodies often precedes the injury of a chronic arthritis of the articular blockage which is shown clinically. Among the clinical conditions, one is marked, for in nearly all of the observations there is recognized the existence of one or more traumatisms. It is necessary to acknowledge that the traumatism plays a rôle in the etiology of the foreign bodies of synovial origin, but this rôle is variable. Sometimes the traumatism appears to be the origin itself of a dry arthritis (Verneuil, Knaggs); sometimes it could have only the effect of breaking the pedicle of the foreign body already formed, and developing the functional disturbances. The experimental researches have shown the action of trauma to the articulations on the development of the lesions of the dry arthritis (Wollenberg, Axhausen). It is necessary to compare these that we have before discussed with the effect of the injections producing the articular phenomenon of Arthus. These various processes,—traumatism, aseptic or septic articular inflammation—certainly exist clinically in man, and may result in the formation of the articular foreign bodies.

On the other hand, the writer feels that it should not be necessary to accept the neoplastic theory of the formation of these foreign bodies,—the so called theory of the osteochondromatosis. It is the opinion held by Reichel, endorsed by M. S. Henderson, that certain of the foreign bodies could result from a chondromatic neoplasm of the synovial capsule, but in the author's opinion there is no argument sufficient to support this theory. Cruveilher has already called attention to the "production of numerous intra-articular organic foreign bodies which develop in an articulation relatively healthy", and surgical interferences in these cases may show, when one knows how to search for it, a focus of a dry arthritis either on the synovial membrane or at the level of the reflection of the periosteal capsule or at the area of the joint border of the cartilage. It is there that foreign bodies are formed, sometimes very numerous (more than a hundred), which are found in the joint. They have, moreover, exactly the same apperance, both macroscopic and microscopic, as those we have studied before. There is no reason for making of this articular chondromatosis a special variety. As to the coexistence of the malignant osseous tumor with the articular foreign bodies, a fact which has been observed once or twice, there is nothing to prove that it was more than a coincidence. In our opinion, it is not advisable to employ severe operations, such as resection of joints, which has been extolled by certain authors; but arthrot-

omy, with the removal of all the foreign bodies, appears to us to be the operation of choice. This excision is not always easy, especially in the hip. There is, however, a tendency to perform this, since the presence of the foreign bodies interferes with the function of the joint, and, by a vicious circle, aggravates the dry arthritis which has been their origin. This dry arthritis, in cases not too far advanced, may recede after a complete cleaning-out of the articulation. Therefore, surgery in the treatment of pathological foreign bodies is advisable.

FOREIGN BODIES OF OSSEOUS ORIGIN

There are several types: the osteophytes, detached from the epiphysis, which is a variety very rare; the foreign bodies developed about the fragments of necrosis of the articular surfaces and foreign bodies of osteochondritis dissecans are the two varieties most important. The relation between the necrosis on the surface of the articular bodies and the formation of the foreign bodies has not been, up to now, very well described; this relation does, however, exist. It is around a small, exfoliated, osseous sequestrum that the foreign cartilaginous body develops as around a nut. In the human this fact was noted by Kirmisson in the tabetic arthropathies, and also has been noted by Fisher in the dry arthritides. Freund has found it recently, and the author has been able to collect several cases. In cutting into the foreign body, one sees at the center a small sequestrum and all about this the cartilage, living and very abundantly calcified (Fig. 6). Foreign bodies of this kind are always free, never pediculated, white, heavy and compact.

Experimentally, the author has reproduced in the *serique* arthritis of the rabbit the exfoliation of the articular surfaces, with the taking up of the small fragments of the necrosed bone by the synovial membrane. In one case, around one of the small sequestra, a foreign cartilaginous body was formed (Fig. 7). Attention has been called many times to this phenomenon "of the pulverization of the articular extremities" and to the many serious consequences which influence the function of the articulation.

Osteochondritis dissecans is one important etiological factor in the formation of these foreign bodies in the joints. It has been studied much already (Broca, Paget, König, and many other recent German writers). Nevertheless, its etiology remains still a matter of dispute. It is a question of the sequestration of a large, osteocartilaginous plate, which is detached from the epiphysis to which it belongs, and falls into the joint cavity. This lesion can be recognized in two different stages,—a sequestrum already in its bed, or quite free. It should be noted that the form is that of a piece of old money. The bony layer is sandwiched between the two cartilaginous leaves,—one part of the articular cartilage is easily shown to have its cellular columns; another part is a layer of neoplastic fibrocartilage (Fig. 8). Were it not for this last neoplastic layer, one would find in the foreign body of the osteochondritis dissecans the structures of a normal epiphysis of a

FIG. 6

Foreign body developed about a small sequestrum.

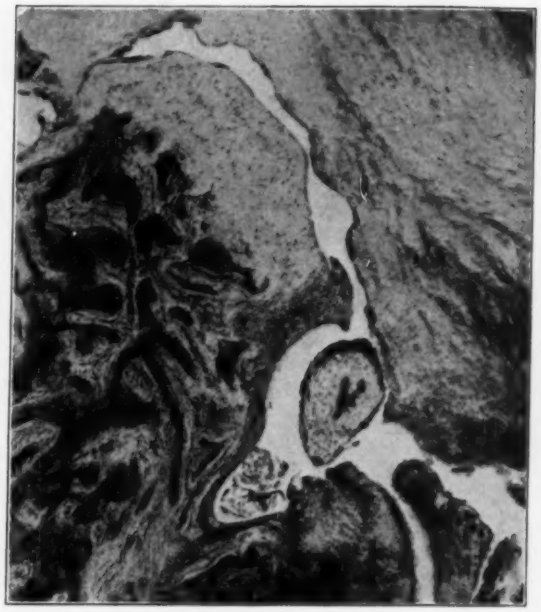

FIG. 7

Experimental foreign body developed about a sequestrum in a *serique* arthritis of the rabbit.

character and formation which differ very definitely from those foreign bodies which have a synovial origin. The osteochondritis dissecans has a seat of predilection. More frequently it is on the medial side of the internal condyle of the femur or on the external condyle of the humerus; the shoulder, hip, and certain small articulations, such as the metacarpophalangeal joints, may be affected. The process is sometimes bilateral and symmetrical.

A search has been made in the study of the histology of the detached fragment, and also of the bed of the epiphysis in which the mass has lain before falling into the articulations, for the indications of the histological character of osteochondritis dissecans. The cartilage and the fibrocartilage of the foreign bodies are living; the bony tissue is dead,—a fact common to all these free articular foreign bodies. It is interesting to note with Lériche and Policard that the sequestrum does not present any histological evidence which would prove that its injury has been sudden and at once necrotic. According to König, Loeb, and Kappis, the reason for this necrosis is a severe traumatism or a series of slight traumas. It has even been suggested that the spine of the tibia, striking on the internal border of the intercondylar area of the femur, plays a rôle in certain movements, but this hypothesis is anatomically false (Mouchet and Noureddine). On the other hand the experimentors have never been able to reproduce the osteochondritis dissecans by an articular traumatism or by an oste-

otomy, after opening the articulation; the fragment detached always fastens itself to the soft part of the articulation and does not become a sequestrum. The traumatic theories, therefore, are not correct. Osteochondritis dissecans is an articular disease. Already its symmetrical character in certain cases (fifteen observations collected by Weil in 1912) definitely shows that it is a question of a pathological systemic lesion. According to Ludloff, it is a result of an anaemic infarct. He explains it as due to the existence of a very small arteriole at this level of the knee, the arteria genu media, so exposed as to be ruptured or to be thrombosed by some violence to the knee. However, the anatomical distribution has not been confirmed, and furthermore, the osteochondritis dissecans may be found, although rarely, at the level of the external condyle (A. Broca). According to Axhausen, the sequestrum results from a bacterial embolism, and in fact there are met with in osteo-articular tuberculosis *séquestres porcelainiques* which have a resemblance to those of the osteochondritis dissecans. According to others (J. Heine) it may be a question of a mycosis.

In the writer's opinion, there is a very definite relation between the dry arthritis and the osteochondritis dissecans: the exfoliation of the cartilage, the partial necrosis of the epiphysis may be the lesions of dry arthritis which, in miniature, produce the process of osteochondritis dissecans. Rocher and Aygueparse have reported an observation where two types of lesions coexisted in the knee. Lecène has observed an osteochondritis dissecans in a tabetic arthropathy, and the anatomical relation between the nerve arthropathy and the arthritis deformans is well known.

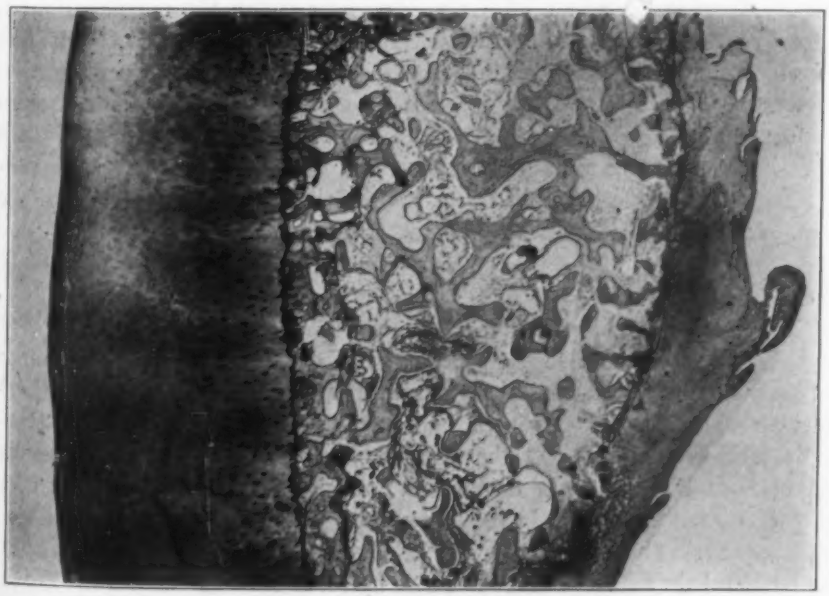

FIG. 8

Foreign body of osteochondritis dissecans.

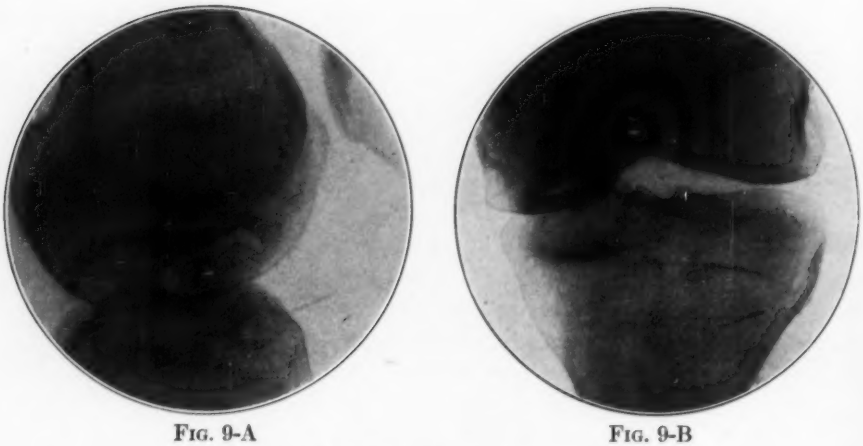

FIG. 9-A FIG. 9-B

X-rays of an osteochondritis dissecans.

Moreover, the German authors hold at present the opinion that osteochondritis dissecans may be one of the lesions of a dry arthritis. Axhausen and Sommer especially have described, in the neighborhood of the forming sequestrum, the lesions of a "subchondral dissection" and of "epiphyseal necrosis", which belong classically to a dry arthritis.

Clinically, the osteochondritis dissecans may be suspected by the presence of pain at a fixed point at the edge of the joint or by the occurrence of a blocking of the joint, but it is the roentgenogram which gives the characteristic evidence (Fig. 9). This indicates clearly surgical interference, because in certain of the young cases, when the cartilage is still present above the fragment of sequestrum, it may be difficult to find this lesion. On exposing the right place, the sequestrum is removed from its lodgment and it is sufficient then to cut the cartilage all around and to raise the fragments from underneath toward the outside. The results of these operations are excellent, and by successive radiographs it has been possible to follow after operation the reconstruction of the bony cortical tissue at the seat of the foreign body, and the cure has been complete.

TRAUMATIC FOREIGN BODIES

These probably are, as the preceding, of bony origin, but their presence has been questioned, and clinically as well as experimentally their authenticity can be disputed. It is probable that some foreign bodies of traumatic origin are found, but they are very rare. In fact, experimentally these foreign bodies may be developed, but only those foreign bodies which are pediculated and which have a very strong tendency to be absorbed and to disappear. These results were published some time ago by Poulet and Vaillard and they have been found also by all of the experimentors (Barth, Hildebrand, Cornil, and Coudray, and recently Schmidt and Ito). It is necessary to observe, meanwhile, that the last one has only once obtained

in a large number of experiments a free foreign body. In the writer's experience with arthrotomies, he has always found the fragment, detached from one of the epiphyses several weeks previously, grafted on the synovial membrane in a recess of the articulation (Fig. 10). An attempt has been made to produce free traumatic foreign bodies in detaching them in an articulation already affected, but they have not been obtained as free bodies. It is necessary to conclude from these numerous corroborating experiences that the traumatic foreign bodies found clinically, if they exist, should be pediculated.

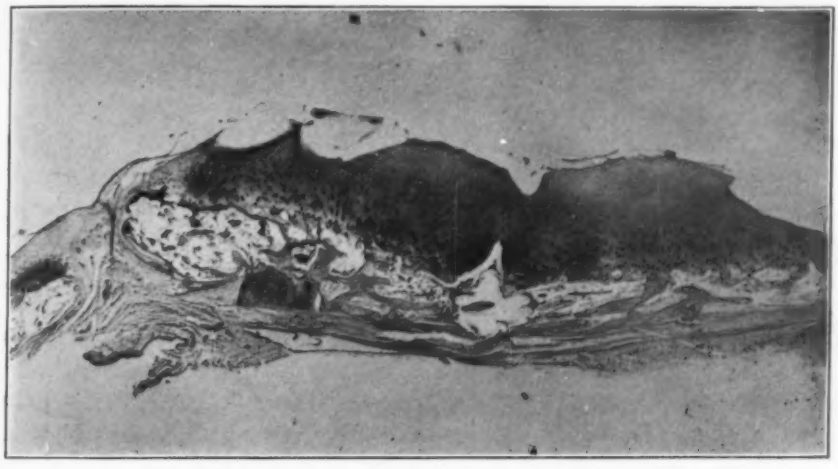

FIG. 10
Pediculated foreign body of traumatic origin.

It is, in fact, a pediculated body, detached from the femoral trochlea in the course of an accident at tennis that the writer has been able to study —a young girl of seventeen—and it is therefore probable that in this case there is a question of the authenticity of a foreign body of a traumatic origin (Fig. 11). The structure is the same as that of the foreign bodies of osteochondritis dissecans,—that is to say, it is flat, made up by an osseous layer in the middle, by a thin covering of cartilage on one side and by a layer of fibrocartilage of neoplastic structure on the other. The cartilaginous layers are alive, and the bone is more or less completely necrosed and secondarily revived. The mode of formation of the fibrocartilaginous layer covering the under side of the fragment has been carefully studied notably by Schmieden and Kappis. It is generally admitted that it is due to the metaplasm of the connective tissue of the synovia in the neighborhood of the osteocartilaginous material which forms the fragment detached from the epiphysis.

In view of these anatomical facts, it is necessary to revise quite considerably many old observations regarding the traumatic foreign bodies, which, in reality, concern the osteochondritis dissecans. The foreign

body of the osteochondritis dissecans is free in the articulation, while that detached by a traumatism in a healthy articulation is covered and pediculated by the synovia. It is this anatomical characteristic which has a diagnostic value.

As to the previous clinical findings, it is seen that they were very doubtful, for the articular traumatism occurred in all varieties, notably in the pathological foreign bodies as a dry arthritis. It is through the pathological anatomy that one distinguishes the different varieties of articular foreign bodies.

THE POSTOPERATIVE PROGNOSIS OF FOREIGN BODIES IN THE JOINTS

This is the important question. *A priori*, one should consider the prognosis in reference to the traumatic and the pathological foreign bodies in a different category. In the first there should be a radical cure after operation; the second is subject to relapses. In reality, this distinction is not always correct. There are many observations in reference to the pathological foreign bodies when a complete and lasting cure has followed operation, but the distinction must be made as to the prognosis of the foreign bodies of a pathological character. Certain ones are entirely curable by surgery, while others, which occur in the course of a severe irremediable articular lesion, represent a less favorable prognosis, whatever is done. This last group comprises, naturally, those of the nerve arthropathies, those of the general arthritis deformans, and also those

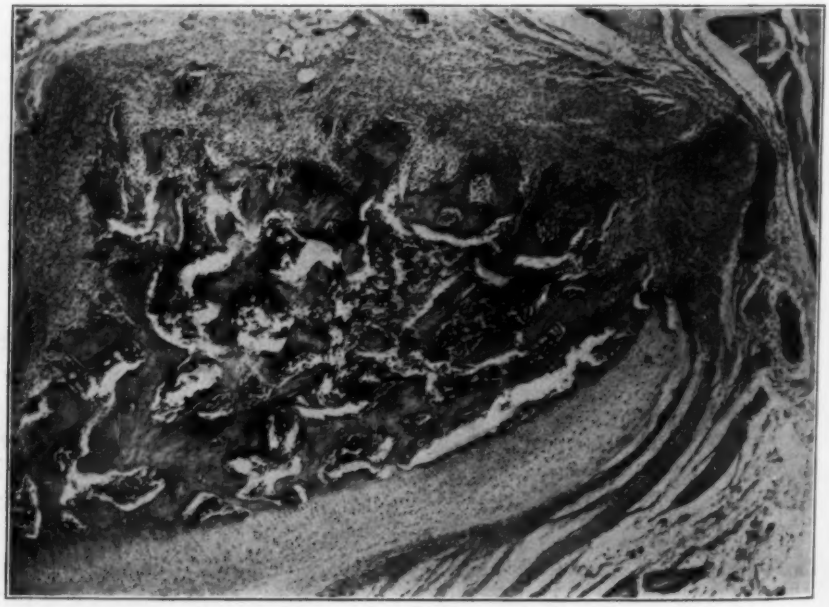

FIG. 11

Traumatic foreign body experimentally obtained, covered by synovia.

where there is an exuberant formation of foreign bodies, not confined alone to the articulations but also to the serous bursae and to the synovia. Surgery, here again, provides only slight relief.

On the other hand, the foreign bodies of synovial origin which exist without other important lesion in the articulation, the foreign bodies of bony origin, and notably those in osteochondritis dissecans, can be removed with complete success and with a definite cure of the articular lesion.

These favorable results can be explained by two facts, which may be emphasized,—the determining rôle of traumatism in the origin of the chronic arthritis, and the frequent multiplicity in the character of the lesions of the arthritis. A dry arthritis in the beginning is not necessarily a progressive and incurable process. Surgery of the pathological foreign bodies shows that it can be beneficial, for the presence of a foreign body in an articulation produces a vicious circle, these bodies aggravating the lesions which are the cause of them. Their surgical removal may arrest the progress of the pathological process and result in a cure of the articulation which was on the way to be destroyed.

Surgery of the articular foreign bodies is, therefore, favorable.

CONCLUSIONS*

There are many varieties of foreign bodies in joints.

The foreign osteocartilaginous bodies are, more often, of pathological origin, formed either from the synovial membrane or from the ends of the bones. Foreign bodies purely traumatic may exist, but undoubtedly are rare.

The traumas to the articulations play an important part in the production of the pathological processes which end in the formation of foreign bodies. The larger number of the articular foreign bodies arise from the processes in the dry arthritis deformans, of which these lesions are characteristic. Another important cause is the condition of that so called osteochondritis dissecans, of which the nature is not understood,—perhaps less distinctly than that of the dry arthritis. We do not admit the reality of the arthritic neoplasia, so called osteochondromatosis, as the origin of foreign bodies.

The pathological findings can best serve to recognize the different varieties of these articular foreign bodies.

The postoperative prognosis of these foreign bodies in joints is good, excepting certain cases in which there are pathological joint lesions which are definitely marked. The traumatic foreign bodies, and many of the pathological as well, may be removed with success and the joints remain normal.

The surgery of the articular foreign bodies is extremely useful.

* See also memoire by P. Moulonguet, Annales d'Antomie pathologique, V., 393 April 1928.

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EXPERIMENTS WITH FOREIGN MATERIALS IN THE REGION OF THE EPIPHYSEAL CARTILAGE PLATE OF GROWING BONES TO INCREASE THEIR LONGITUDINAL GROWTH

BY HAROLD R. BOHLMAN, M.D., BALTIMORE, MD.

Kiwanis Fellow. The Children's Hospital School, Baltimore, Md.

One does not need to mention the necessity for some certain and reliable means to stimulate the length-growth of long bones. Clinically many causes enter into the production of shortening deformities,—just as, conversely, many causes produce an unusual longitudinal growth. Among such causes are trauma, congenital deformities, vascular disturbances, rickets, osteomalacia, osteitis deformans, syphilis, chronic or acute illness, chronic or acute infections of the bone, especially in and about the metaphysis; osteomyelitis is a common agent in this respect.

The use of ivory or bone pegs driven into the femoral or tibial epiphyses, or both, is advocated by some clinicians and condemned by others. Goldthwait states that in cases where slight infections or sloughing has occurred about the pegs, the stimulation was more marked. It would seem a rather difficult matter to check the results in these cases where trophic disturbances vary markedly, and where a corrective operation or brace during the pegging period increases function and thereby influences growth. In addition to checking the affected limb length against the normal side it would seem necessary to establish a factor of growth rate for a long period of time before and after the pegging operation.

In going through the literature, one does not find a great deal of experimental work directly dealing with epiphyseal stimulation. One would like to know more of the effect of various neurological lesions and trophic disturbances on the growth mechanism of the epiphyseal cartilage plate region and of the concomitant histologic changes which take place in this region.

Vogt[1], Jahn[2], and Haas[3] carried on experiments in growing animals, attempting to discover local factors in the length-growth regulatory mechanism of this region. Their experiments consisted of trauma, separation, and excision. Haas arrives at the conclusion that "The most active and important elements necessary for longitudinal growth are located in the columns of cartilage of the epiphyseal cartilage plate".

Meisenbach[4] carried out a series of experiments with growing rabbits. He injected various substances into the region of the tibial epiphyseal cartilage plate; these consisted of sterile water, graphite pegs, staphylococcus pyogenes aureus vaccine, the latter two combined, tincture of iodin, carbolic acid, and formalin. These were narrowed down to the

FIG. 1
(×⅓) X-ray following operation.

use of formalin as the most suited to the purpose through its affinity for protoplasm. He secured local stimulation of bone growth, but with premature ossification of the epiphyseal cartilage plate, and consequently the final result was a shortening rather than an increase in length. Recently Harbin[5] injected a bacterial suspension of staphylococcus aureus into the epiphyseal cartilage plate region of a puppy. He states that dogs have a high resistance to this organism. The infection remained localized and the final result was some rarefaction of the bone with a noticeable shortening.

In this series of experiments no attempt was made to cover the ground from neurologic or general systemic standpoints; but simply to take up the local problem of stimulating length-growth of a femur by introducing a wide range of foreign materials into the region of the epiphyseal cartilage plate of growing animals.

Guinea-pigs were selected because they represent a rapid or condensed period of growth; tend to react uniformly; are quite resistant to the ordinary infections; tolerate ether weil; are small enough to facilitate gross study, sectioning, and microscopic study.

A number of animals were sacrificed in perfecting a technique delicate enough to insure accuracy in so small an anatomy. A routine was established which was varied as little as possible throughout the entire lot of animals. The animal was clipped about the leg, thigh, and hip; the knee joint was shaved. The animal was then completely anaesthetized with

ether and the shaved and clipped area painted with five per cent. picric acid in ninety-five per cent. alcohol. Sterile towels were used for draping and aseptic technique used throughout. A medial longitudinal incision was made over the outer, lower half of the left thigh and carried down to the muscles, which were separated by blunt dissection and the outer supracondylar epiphyseal line exposed. A three-sixty-fourths inch dental drill, or burr, was used to drill a hole entirely through the bone, parallel to the plane of the epiphyseal cartilage plate. Four animals were used for each substance, and in each series of four the position of the hole was varied as shown in Figure 5*a*. One hole was run through the apex of the V, attempting to cut through the cartilage. Two more, one on either side of the V, were run through the metaphysis as close to the cartilage plate as possible. The fourth was placed just inside the apex of the V in the epiphysis as close to the cartilage plate as possible.

Powders and crystals were inserted with a cannula and trocar of about the same bore as the drill. Pegs were made to fit snugly and were tapped or pressed into place so that the ends were flush with the bone surface on either side of the femur. The inner surface could be readily palpated. The joint cavity was not opened or disturbed. But very little bleeding was encountered except from the drill holes. This was stopped with the plugging; the superficial bleeding was stopped by clamping. The subcutaneous fascia was closed with three interrupted black silk sutures, the skin in a like manner; followed by an alcohol and ether wash, and the wound was finally covered with flexible collodion. The animals

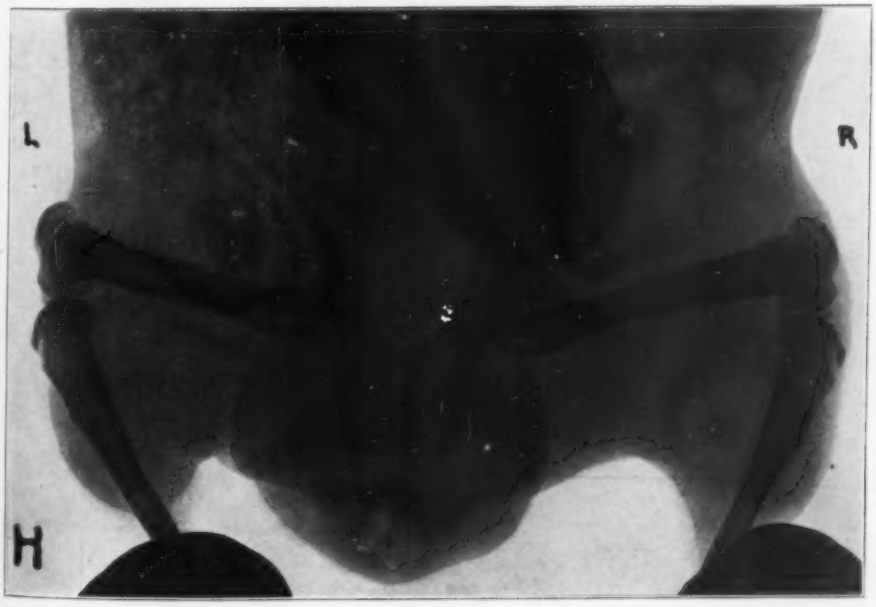

FIG. 2
(×⅛) X-ray before autopsy.

FIG. 3

(× 13) *H*. Section through dry beef bone peg. Note obliteration of epiphyseal line.

FIG. 4

(× 12) *G.* Section through resinous pine peg. Note practically normal epiphyseal line with peg well up in metaphysis.

themselves removed the collodion and skin sutures in from seven to fourteen days. The wounds, without exception, healed per primum. No infections occurred in any of the animals. Only two died prematurely; these will be mentioned later.

The operations were performed with a minimum of trauma and with as little interference to circulation as possible. The latter has been well worked out by Lexer[6], Haas[7], and Johnson[8]. The functional factor in relation to growth was negligible in the final outcome; all of the joints had full free motion at autopsy. Following operation, the joints showed but slight swelling and limitation of motion, except series *D* and *L*. This had entirely disappeared at the end of ten days or less. In series *D*, in which black copper oxide was used, the reaction was immediate and severe. These animals soon developed marble-sized fluctuant tumors at the site of operation. On aspiration a sterile straw-colored fluid was obtained from each. It was flecked with bits of the oxide. After operation the swelling gradually subsided and in twenty-five to thirty days was not noticeable and motion was normal. In series *L*, in which a staphylococcus aureus vaccine paste was used, one animal died immediately after injection with symptoms resembling anaphylactic shock. The three remaining animals of this series were the only ones of the entire lot to show general or systemic effects after operation. They ate poorly, their fur was rough, and the operative site tender, swollen, and feverish for ten days; aspiration culture was sterile, after which the general condition improved rapidly, the swelling subsided, and in fifteen to twenty days the animals were normal generally and showed no local swelling. One animal in series *I*, in which non-resinous pine pegs boiled in paraffin were used, died prematurely of some intestinal disturbance. Operative site was quite normal. All animals used hind legs equally well.

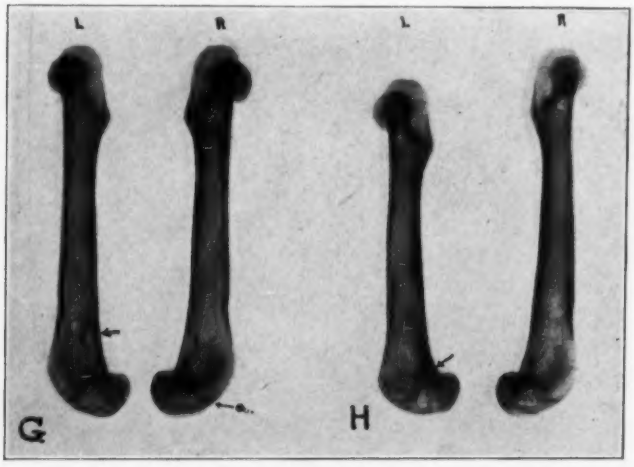

FIG. 5

Actual size.

G. Gross appearance of femur with pine peg. Arrow marks end of peg.

H. Gross appearance of femur with beef bone peg. Arrow marks end of peg.

a. Points at which various drill holes were made.

The animals at operation had an average weight of 186 grams, while at autopsy average weight was 420 grams. The period between operation and autopsy averaged eighty-five days; the variation being but a few days more or less. Uniform conditions of food and care were maintained as nearly as possible. Sexes were kept separate and were evenly apportioned among the experiments. Control x-rays were made of the lower half of each animal within forty-eight hours after operation (Fig. 1); again after forty days; and finally, just before autopsy (Fig. 2). Ninety-two animals, in addition to those used in perfecting technique, were employed to carry out experiments with twenty-two substances or combinations, with a series of four animals to each. Four were used as controls in which nothing was inserted in the drill holes. The materials used represent a wide range and were both organic and inorganic and also from animal and vegetable origin. All were autoclaved at fifteen pounds pressure for twenty minutes, except *T* series, in which autogenous bone pegs were used.

The series run:—

A. Iron pegs.
B. Copper pegs.
C. Lead pegs.
D. Red iron oxide.
E. Black copper oxide. } Powders, relatively insoluble salts.
F. Lead carbonate. }
G. Resinous or "greasy" pitch-pine pegs.
H. Dry beef-bone pegs.
I. Non-resinous pine pegs boiled in paraffin.
J. Pegs of freshly extracted resin.
K. Absorbent cotton soaked in balsam of Peru.
L. Vaccine paste of staphylococcus aureus; cultured from a case on the ward, of a low-grade osteomyelitis in the metaphysis of a femur, which had produced about three-fourths of an inch of lengthening in the affected side.
M. Asphalt pegs.
N. Gum camphor. }
O. Menthol crystals. } Essential oils.
P. Thymol crystals. }
Q. Pine pegs without pitch or resin.
R. Ash-wood pegs.
S. Oaken pegs.
T. Small autogenous bone pegs.
U. Ivory pegs.
V. Control animals with drill holes only.
W. Guinea-pig bone pegs, boiled and dried before autoclaving.

No abnormalities of the viscera were noted in any of the animals. There was normal range of motion in left knee of each animal. Each pair of femora was dissected out intact and "fixed" in ten per cent. formalin; their lengths compared; relative shapes and contours studied; and an x-ray of each pair made with the condyles on a common line, thus giving an accurate record of structure and lengths (Figs. 7, 8, and 9). An average

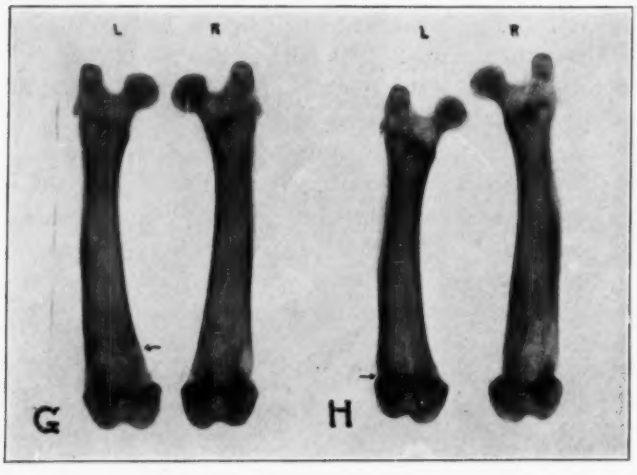

FIG. 6
Actual size.

specimen was then selected from each series; the left femur was cut across the shaft in the mid-portion, the upper half being discarded. The lower half or condylar portion was decalcified with nitric acid and phloroglucin; imbedded in celloidin; sectioned in the medial plane of the shaft, through the foreign material. Hematoxylin and eosin stain was used; some of the sections were stained with Van Geison's connective-tissue stain. Sections were mounted in balsam. Other specimens were studied grossly, after boiling the bone in solution of sodium hydrate (Fig. 10). In others the pegs were removed for gross study. Epiphyseal cartilage plate will be referred to as a "line" in the sections.

RESULTS:

A. Iron pegs (Fig. 7).

Gross Appearance: Left femora were shortened one-sixteenth of an inch or more. There were small fibrous depressions at sites of drill holes. Lower ends of shafts were flattened; external condyles were smaller than normal. Pegs were eroded, with much black debris about them.

X-ray: Pegs remained in almost the same positions in which they were placed; some rarefaction about them. Cancellous bone of metaphyses was rarefied and deranged.

Microscopic: Epiphyseal line is irregular; cartilage columns shortened and their cells flattened. At the center the line is completely ossified for a space. A fibrous capsule covers the peg and much black debris fills its inner border, where the cells are necrotic. There is no tendency to bone-shell formation about the peg. Cortical bone, with fibrous ingrowths, fills the drill holes. Trabeculae are quite normal as is the marrow, except for some increased density about the peg.

B. Red iron oxide (Fig. 7).

Gross Appearance: Left femora shortened three-sixteenths of an inch. Inner condyles are somewhat hypertrophied, while the outer are smaller than normal. Lower ends of shafts are thickened and rather wide.

X-ray: Iron oxide masses are in the epiphyses and metaphyses approximately where they were placed; some rarefaction of the cancellous bone in the latter.

Microscopic: Epiphyseal line has lost all normal structure, is merely dense, irregular cartilage. Central portion is occupied by the mass and trabeculae. Very moderate fibrocellular reaction about the former. Drill holes are filled with cortical bone. Marrow is denser than in *A*.

C. Copper pegs (Fig. 7).

Gross Appearance: Left femora shortened three-sixteenths of an inch or more. Lower ends of shafts are quite wide and thick. Copper pegs are quite eroded.

X-ray: Wide zone of rarefaction about the pegs which are slightly above the epiphyseal line.

Microscopic: Epiphyseal line is a jumbled mass of cartilage cells, entirely replaced in the center with trabeculae. There is complete fibrous encapsulation of a mass of debris which surrounds the peg. Much bone has formed in and about this capsule, and at one point there is considerable dense bone formation in the debris. Marrow is quite normal. Cortical bone fills the drill holes.

D. Black copper oxide (Fig. 7).

Gross Appearance: Left femora shortened one-sixteenth of an inch or more. Shafts are wide at lower ends and the condyles have grown backward at quite an abnormal angle.

X-ray: Increased density of the metaphyses. Masses visible slightly above the epiphyseal line.

Microscopic: Epiphyseal line is quite wide; cartilage columns are long and stretch out to a mass of rarefied cartilage at the outside of the shaft. Here is a vacuolated area with but few particles of the oxide remaining. Cortical bone tends to grow back or around the inner side of this area; periosteum, fibrous tissue, and muscle tissue mingle at the outer side, where the external condyle overhangs the area. Trabeculae are numerous in both the epiphysis and metaphysis, with apparently a marked tendency to solid bone formation. Marrow cells are quite densely packed.

E. Lead pegs (Fig. 7).

Gross Appearance: Left femora shortened one-sixteenth of an inch or more. Condyles have grown with an inward and backward rotation. In three the outer condyles were rather small. Pegs were eroded and the protruding ends covered with fibrous tissue.

X-ray: No rarefaction about the pegs.

Microscopic: Epiphyseal line quite normal in outer portion; becomes flattened toward the center, where for quite a space it is entirely replaced by trabeculae; inner portion is composed of flattened cartilage cells with no columns. Black masses and bits of debris are scattered for quite a

distance in the epiphyseal and metaphyseal marrow, with but little cellular reaction about them. A very thin layer of fibrous tissue covers the peg and outside of this is a thin shell of bone forming at many points. Cortical bone covers the inner end, while a very thin layer, with normal periosteum, covers the outer end.

F. Lead carbonate (Fig. 7).

Gross Appearance: Left femora shortened one-sixteenth of an inch. Condyles have some backward angulation; outer ones rather small.

X-ray: Masses show clearly in original positions, but have been somewhat scattered, or diffused.

Microscopic: Epiphyseal line is quite normal in outer portions, while at the center is a large cartilage mass. Heavy bone trabeculae tend to surround the mass. There is but little fibrous reaction and these cells are diaphanous. At many points the carbonate particles lie next the bone with no fibrous cells intervening. Cortical bone fills the drill holes; marrow is quite normal.

G. Resinous pine pegs (Figs. 7, 4, 5, and 6).

Gross Appearance: No shortening, except a very slight amount in the one in which the peg was placed just above the epiphyseal line,—this was slight. Shape and contours quite normal throughout. Pegs are well up in the shafts, the ends protrude slightly.

X-ray: Normal density throughout. Pegs are well defined in the shafts.

Microscopic (Figs. 4 and 11). Epiphyseal line, marrow, trabeculae, and cortical bone are normal. The latter forms a thin layer, with normal periosteum over the inner end of the peg; its outer end is covered with fibrous tissue. A thin fibrous capsule covers the peg and outside this is an almost complete, well formed, thin bone shell. There is apparently little interference to normal bone growth and structure.

H. Dry beef-bone pegs (Figs. 7, 1, 2, 3, 5, and 6).

Gross Appearance: Left femora shortened three-sixteenths of an inch. Some flattening of lower ends of shafts; with slight backward angulation of the condyles.

X-ray: Pegs remain in the epiphyseal cartilage plate region with marked increase in density about them.

Microscopic (Figs. 3 and 12). Epiphyseal line is obliterated by the peg, except the inner portion where the cartilage cells are rounded and show no column formation. Outer end of the drill hole is filled with fibrocartilaginous material. The beef bone is undergoing absorption, and blood vessels appear in some of the enlarged canaliculi. There is no fibrous reaction about the peg, but in some places there is a very thin shell of new bone forming.

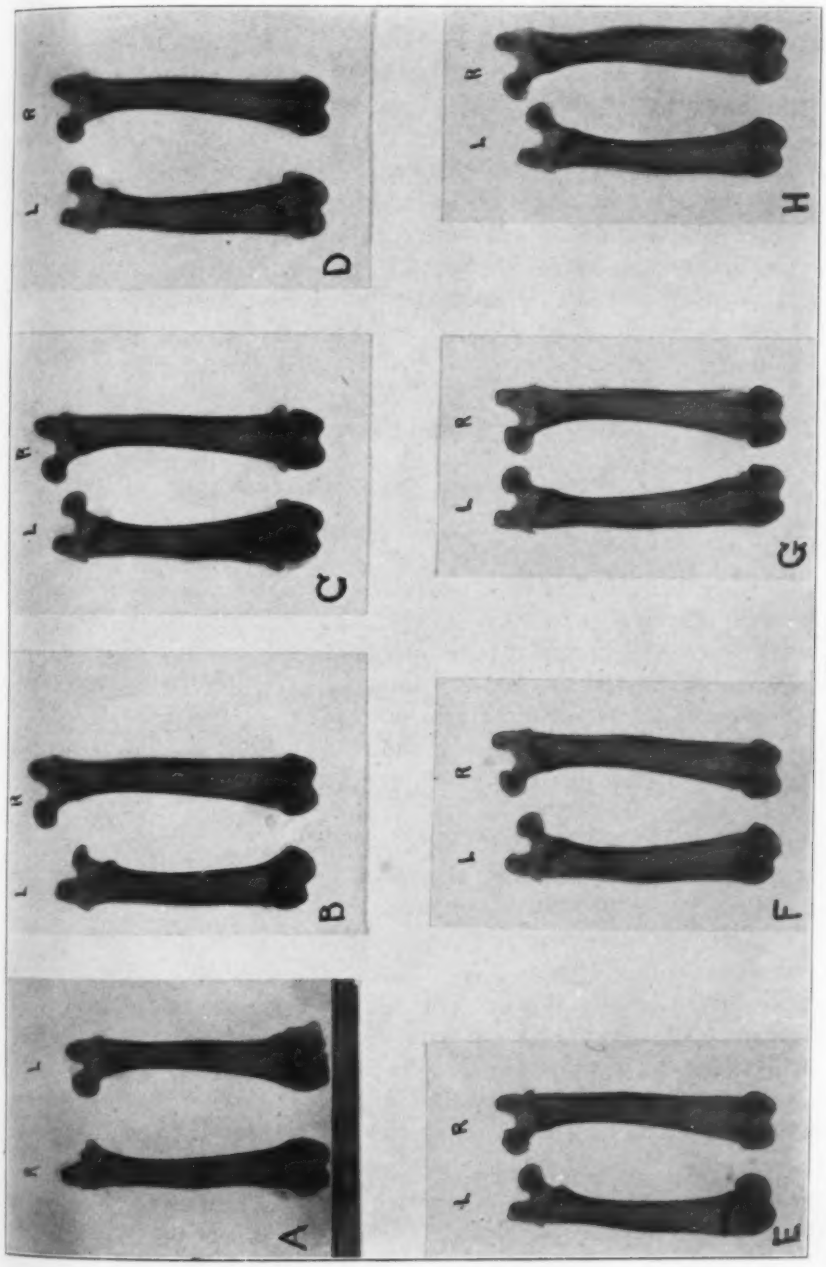

FIG. 7

(Series *A–H*, actual size.)

A. Iron peg.
B. Copper peg.
C. Lead peg.
D. Red iron oxide.
E. Black copper oxide.
F. Lead carbonate.
G. Resinous or "greasy" pitch pine peg.
H. Dry beef bone peg.

I. Paraffined non-resinous pine pegs (Fig. 8).

Gross Appearance: Left femora shortened one-sixteenth of an inch or less. Fibrous tissue covers peg ends, which protrude slightly, well up in the shafts. Three show some outward bowing of the shafts; the lower ends of these shafts are flattened.

X-ray: Bone density quite normal. Pegs are well defined in cortical bone only.

Microscopic: Epiphyseal line shows normal cartilage cells in the outer portion; the columns are prolonged at the center, while in the inner portion they are short and the cells flattened. The peg has a fibrous covering, in which the cells are fairly large. Only the cortical bone tends to shell formation about the peg; it protrudes into the marrow cavity on either side for a short distance.

J. Resin pegs (Fig. 8).

Gross Appearance: Left femora shortened three-sixteenths of an inch. Condyles show some backward angulation.

X-ray: Pegs do not show; cancellous bone of metaphyses is irregular.

Microscopic: Epiphyseal line is irregular; the cartilage columns are obliterated and the cells flattened in the outer portions, while the center is replaced by trabeculae. The latter are almost entirely lacking in the metaphysis. The resin is practically dissolved away; a vacuolated area remains with little or no fibrous capsule formation; the marrow cells are quite densely packed,—more so about this area,—and here they shade off into an amorphous, eosin-staining, inner border. Little vacuolated areas appear in the marrow. The drill holes are filled with irregular cortical bone.

K. Balsam of Peru and cotton fibers (Fig. 8).

Gross Appearance: Left femora shortened less than one-sixteenth of an inch. Lower ends of shafts are somewhat flattened.

X-ray: Well defined shadows in the shafts show location of the foreign masses; otherwise normal detail.

Microscopic: Epiphyseal line is quite normal; only slight irregularity of the columns. Marrow is rather dense. Some fibrous tissue reaction among the cotton fibers, with immense numbers of small, irregular bone trabeculae in whorls and bizarre forms. These are large near the cortex. Drill holes are filled with irregular cortical bone, which is quite thick at the inner side.

L. Staphylococcus aureus vaccine paste (Fig. 8).

Gross Appearance: Left femora shortened about two-sixteenths of an inch.

X-ray: Increased density in epiphyseal cartilage plate regions. Cancellous bone of the metaphyses is irregular.

Microscopic: Epiphyseal line is normal at the outer portions; toward

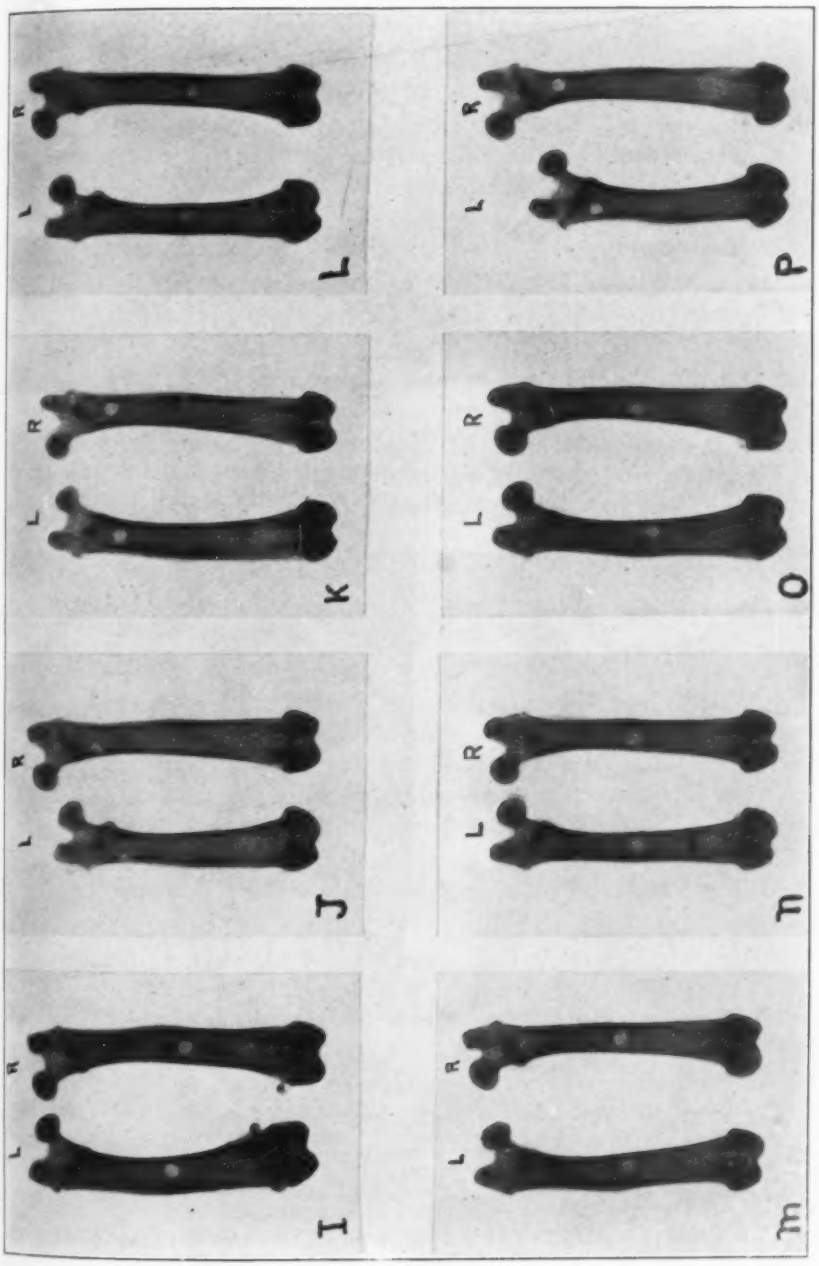

FIG. 8

(Series *I–P*, actual size.)

I. Non-resinous pine pegs boiled in paraffin.
J. Pegs of freshly extracted resin.
K. Absorbent cotton soaked in balsam of Peru.
L. Vaccine paste of staphylococcus aureus.
M. Asphalt peg.
N. Gum camphor.
O. Menthol crystals.
P. Thymol crystals.

the center the columns are shorter, the cells rounded; at the very center, the columns are prolonged into a mass of cartilage which extends well into the metaphysis. The marrow is very vascular. The vaccine paste has left a vacuolated area in this tissue with no bone formation about it. The fibrous encapsulation is very thick and composed of cells with an epithelioid appearance; these shade off to an almost necrotic inner border. This capsule contains several nests of large, deeply basic staining cells. Inner portion of the drill hole contains irregular cortical bone; the outer is much the same, but with an oblique strip of cartilage.

M. Asphalt pegs (Fig. 8).

Gross Appearance: Left femora shortened about one-sixteenth of an inch. Lower ends of shafts are flattened a little. The ends of the pegs show well up in the shafts.

X-ray: Only faint haziness in regions of pegs; otherwise normal.

Microscopic: Epiphyseal line is normal except for slight shortening of cartilage columns in the outer portion. Trabeculae are normal, as is the marrow. The asphalt mass is well up in the shaft, with but little fibrocellular reaction about it. Drill holes filled with irregular cortical bone.

N. Gum camphor (Fig. 8).

Gross Appearance: Shortening of left femora is about one-thirty-second of an inch.

X-ray: Camphor masses give irregular shadows in lower ends of the shafts.

Microscopic: Epiphyseal line is quite thick; in places the cartilage columns are three times their normal length; trabeculae replace cartilage cells in the outer portions. The epiphysis contains but little marrow, while in the metaphysis the cells are densely packed, especially about the empty area from which the camphor has been dissolved. No fibrous reaction is present; the marrow cells are almost necrotic about the inner border of this area.

O. Menthol (Fig. 8).

Gross Appearance: Left femora shortened about one-thirty-second of an inch.

X-ray: Increased density in the epiphyseal cartilage plate regions. Cancellous bone of the metaphyses shows some derangement and rarefaction.

Microscopic: Picture practically like that in *N*, except that there is no ossification of the epiphyseal line, the columns are shorter, and there is a deeper area of cell reaction about the space which the menthol occupied.

P. Thymol (Fig. 8).

Gross Appearance: Left femora shortened three-sixteenths of an inch. Contour of bones fairly normal.

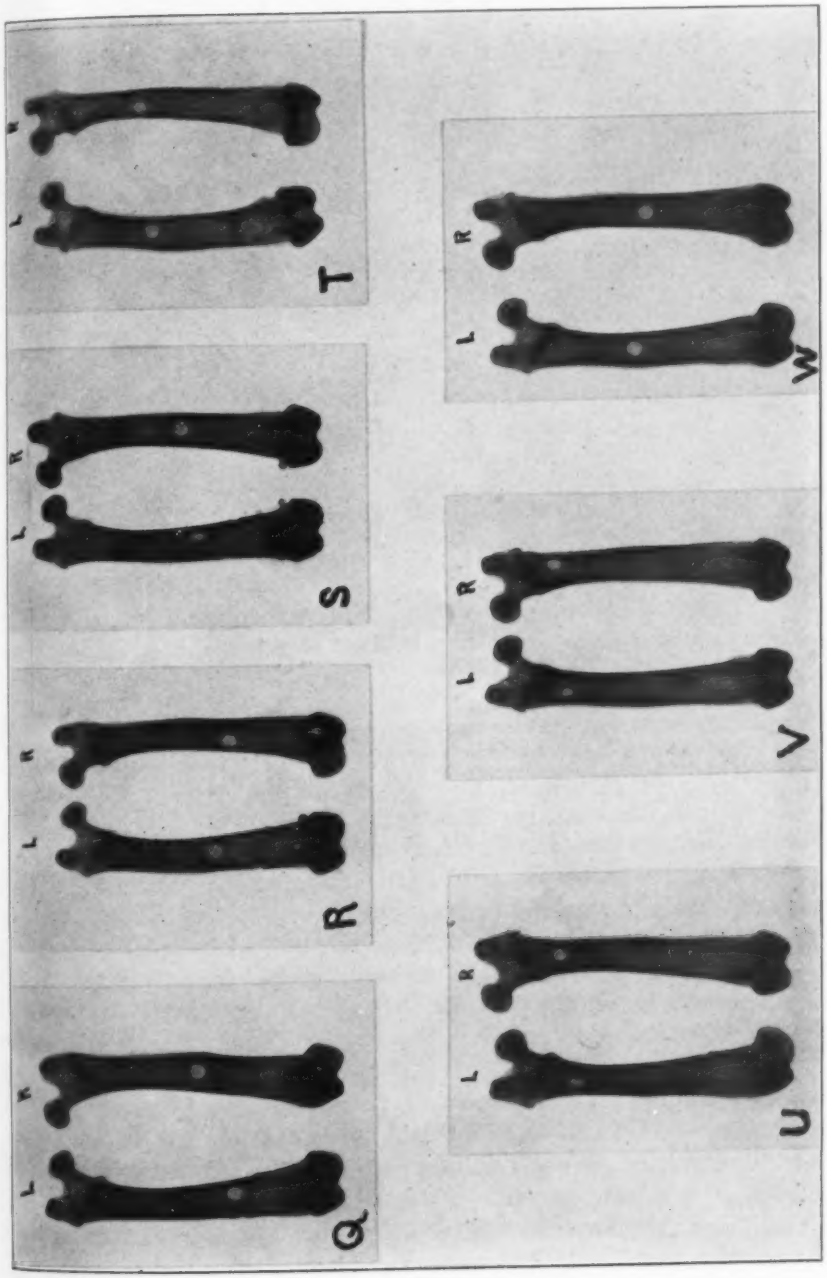

FIG. 9

(Series *Q–W*, actual size.)

Q. Pine pegs without resin.
R. Ash wood pegs.
S. Oaken pegs.
T. Autogenous bone pegs.
U. Ivory pegs.
V. Control animals with drill holes only.
W. Guinea pig bone pegs.

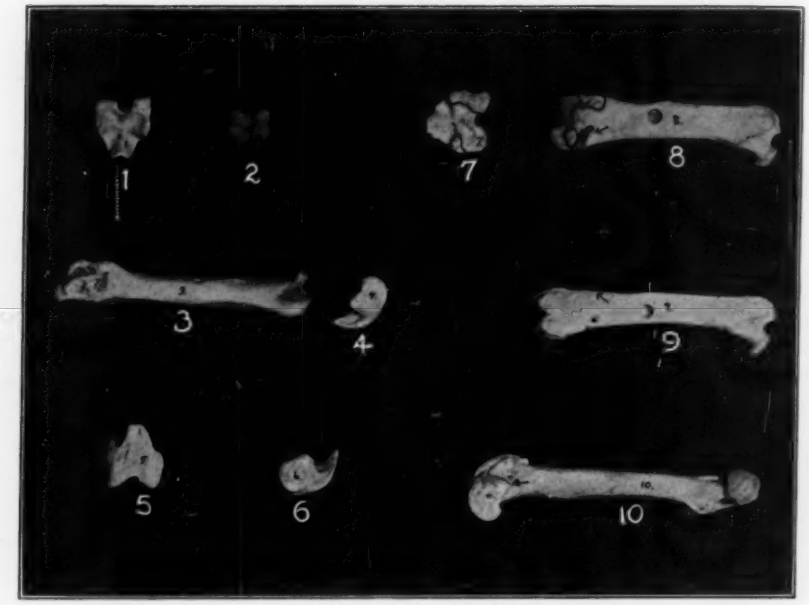

FIG. 10

(¾ actual size.)

1, *4*, *5*, and *6*. Normal epiphyses. Give an idea of the shape of the cartilage plate, also the relation of the variously placed masses.

2. Normal end of shaft.

3 and *10*. Normal shafts.

7 and *8*. Left femur, shaft, and lower epiphysis from series *U*. The ivory peg is partially withdrawn. The areas shown by irregular ink lines are the areas of premature ossification in the epiphyseal cartilage plate.

9. Shaft of left femur from series *R* showing peg ends in shaft.

X-ray: Some rarefaction of metaphyses; masses show faintly in them.

Microscopic: Epiphyseal line has entirely disappeared and the trabeculae run from epiphysis to metaphysis without a break. The drill holes are filled with cortical bone. No trace of thymol or cellular reaction remains. This was by far the most severe and toxic reaction of the last three groups,—*i.e.*, the essential oils.

Q. Non-resinous pine peg (Fig. 9).

Gross appearance: Left femora were shortened one-thirty-second of an inch or less. Peg ends protrude well up in the shafts, covered with thin fibrous tissue. Contours normal.

X-ray: Normal appearance, pegs well defined.

Microscopic: Epiphyseal line appears normal; likewise marrow and trabeculae. Wood fibers are unchanged and are surrounded by little fibrous tissue; outside this is a thin bone shell formed by trabeculae and cortical bone. Peg ends are covered with fibrous tissue which is continuous with the periosteum.

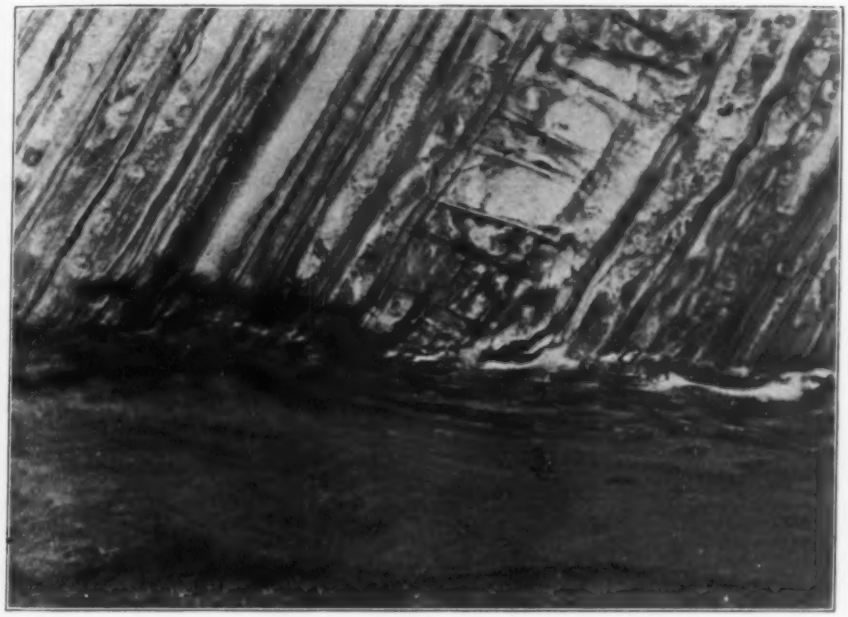

FIG. 11

G. 1 Wood fibers; *2* Fibrous capsule; *3* Cortical bone.

R. Ash-wood pegs (Fig. 9).

Gross Appearance: Left femora shortened one-thirty-second of an inch or less.

X-ray: Normal appearance; pegs show clearly, well up in the shafts.

Microscopic: Epiphyseal line is normal except for some lengthening of the cartilage columns, especially in the outer portion. Cortical bone covers the peg ends in this specimen. The peg has more fibrous tissue about it than any of the preceding wooden pegs, also a heavier bone shell. Diverticulous processes of bone dip into depressions in the wood. Fibers of the latter are unchanged.

S. Oaken pegs (Fig. 9).

Gross Appearance: Left femora shortened one-thirty-second of an inch or less.

X-ray: Normal appearance; pegs are well defined, high up in shafts.

Microscopic: Epiphyseal line is quite normal. Picture is similar to that of *R*, except that wood fibers show slight disintegration at the peg ends. Marked bone shell formation about the peg.

T. Autogenous bone pegs (Fig. 9).

Gross Appearance: Left femora shortened one-sixteenth of an inch or less. Normal contours.

X-ray: Normal appearance; pegs show indistinctly, and in only one specimen is the peg well above the epiphyseal cartilage plate.

Microscopic: Epiphyseal line shows normal structure except at the center, where the cartilage columns are elongated and for a short space are replaced with trabeculae. Bone peg cells are viable. The cortical bone and trabeculae are uniting with the peg, which is rather irregular in outline.

U. Ivory pegs (Fig. 9).

Gross Appearance: Left femora shortened one-sixteenth of an inch. Lower ends of shafts are somewhat flattened. In three the external condyles are smaller than normal.

X-ray: Some rarefaction of the metaphyses. Pegs are fairly well defined some distance above the epiphyseal cartilage plates.

Microscopic: Epiphyseal line is normal except at the center where the cartilage columns are longer than normal, and for a space are replaced by trabeculae. A fibrous capsule covers the peg and outside this in places is some tendency to bone-shell formation. Ivory is unchanged.

V. Drill holes (Fig. 9).

Gross Appearance: Slight if any shortening in left femora; some in the one in which the drill hole was placed on the epiphyseal side. Normal contours.

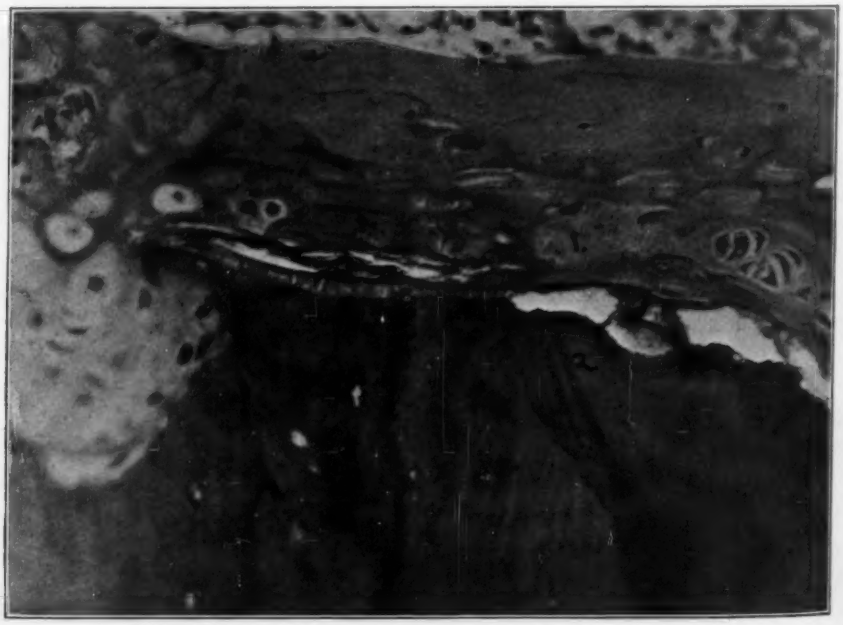

FIG. 12

H. *1* Cortical bone; *2* Beef bone.

X-ray: Normal appearance, except for a little irregularity at sites of the drill holes in two.

Microscopic: Epiphyseal line normal. Drill holes filled with cortical bone, which as usual, shows slight structural irregularity of arrangement.

W. Boiled bone pegs of guinea-pig bone (Fig. 9).

Gross Appearance: Left femora shortened one-sixteenth of an inch. Normal contours except in two which show some backward angulation of the condyles.

X-ray: Some rarefaction of the condyles; pegs do not show well.

Microscopic: Essentially the same as in *H.* (In the microscopic study, "drill holes" refer to the hole in either side of the shaft in the cortical bone.)

A number of the femora were prepared for gross study by boiling them in a solution of sodium hydrate. The extent of the areas of premature ossification of the epiphyseal cartilage plate showed clearly in these specimens, and were found to vary somewhat with reference to the point at which the drill was introduced. In each series, the one placed above the cartilage plate—*i.e.*, in the epiphysis—gave the greatest amount of shortening and also the greatest amount of prematurely ossified area of cartilage plate (Fig. 10).

CONCLUSIONS

1. The foreign materials used did not produce an increased growth in length in any of the animals. Instead, a marked shortening often resulted.

2. This series of experiments does not warrant the clinical or surgical use of foreign materials in the epiphyseal cartilage plate region to promote the length-growth of bones.

3. These experiments afford an interesting study of the reaction of young, growing bone cells to various foreign materials; and give a relative idea of their toxicity, or cell reaction of bone to a wide range of materials. Some of these are mentioned in the literature. The reaction of bone to metals has been worked out by Zierold[9] and others. One finds little mention of woods. They seem to be quite innocuous to the bone cells and apparently interfere but little, if any, with the normal growth processes. Apparently they tend to stimulate bone-shell formation about themselves. More experimental work, with a view to their possible use in bone surgery, should be done.

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THE DETERMINATION OF PRE-OPERATIVE INDICATIONS FOR CORRECTION OF BONE DEFORMITIES

BY R. PLATO SCHWARTZ, M.D., ROCHESTER, N. Y.

From The Department of Surgery, The University of Rochester School of Medicine and Dentistry

The need for greater accuracy in determining the point of election and shape of the section in a long bone for correction of angular deformity is emphasized by,—(1) the frequent occurrence of such deformities; (2) the incomplete corrections obtained by decisions based upon estimates during the stress of operating; and (3) the probability of giving the patient something less than the best result which it is possible to obtain, without careful pre-operative determinations.

Abnormal curvatures in long bones, such as those due to rickets, present difficult problems due to their occurrence in more than one plane and the presence of rotation in the longitudinal axis. Angular deformities resulting from trauma in the long bones usually affect a smaller region in the length of the diaphysis, and they may occupy only one plane with or without rotation.

The correction of such deformities requires a solution of continuity of the deformed bone by osteoclasis or by open operation. The inaccuracies of the former procedure, and resulting incomplete corrections obtained, have led to supplanting it by the open method. Infection and non-union are possibilities which must always receive serious consideration where an operation is advised for this purpose. Both of these effects can be reduced to a minimum by following well defined preventive measures, which include pre-operative facts pertaining to the general and local condition together with rigid operative technique and postoperative care. Strict observation of all prophylactic measures may not, however, prevent the occurrence of these or other infrequent complications.

The general adoption of open operation for correction of these deformities has emphasized the superiority of the method. The incomplete corrections obtained have been accepted,—first, because they are better than those resulting from osteoclasis, and second, they are further diminished by compensatory changes incident to growth and restoration of more nearly normal functions in the extremity.

It seems apparent, therefore, that the patient is entitled to that pre-operative consideration which will assure the maximum correction of deformity; thereby shortening the period of convalescence and relieving him from residual uncorrected deformities which follow in the wake of operations done without careful planning. Such pre-operative consideration emphasizes the accuracy essential to the location and direction of each

cut to be made through bone for the correction of the given angulations. It soon reveals the fact that there is a small latitude for deviation when one is restrained by preventing shortening and impelled to gain the maximum correction.

The method employed during the past year requires that x-ray negatives of the deformity be carefully made in true lateral and anterior-posterior views. It is advisable to get as much of the affected bone on each negative as conditions will permit. Tracing paper is placed over the negative and in this way a line drawing is made of the deformity in each plane. The longitudinal axis is drawn down the center of the diaphysis proximal to the deformity; then at the level of the deformity the drawing is cut through at right angles to the longitudinal axis of the diaphysis. The proximal half is pasted to a sheet of paper on which the lower half is also pasted after placement so as to restore the outline and longitudinal axis to its most normal position. This procedure is completed for both anterior-posterior and lateral views. The amount of overlap of the paper at the junction of the proximal and distal portions designates the shape of the wedges, and the point of junction determines the level at which the wedge should be removed. Not infrequently, especially in deformities such as the tibial bowing due to rickets, complete correction requires section at two levels, if one is to avoid the inevitable shortening which results from attempting to gain full correction by the removal of only one compound wedge. A simple wedge (Fig. 1*a*) may be defined as one which has a base of X thickness and tapers equally on each side to the apex at a point opposite the base. A compound wedge (Fig. 1*b*) is one which has a base of given thickness continued to one side so that the two sides do not taper equally toward the apex of the wedge; such a wedge is used only where there is a curvature in two planes. It is only by pre-operative estimation of these procedures that full appreciation of the various planes involved can be defined through the visualization of angles and shapes of wedges which must be removed for this correction. Frequently it will be found that, although considerable bone may be removed at one or two

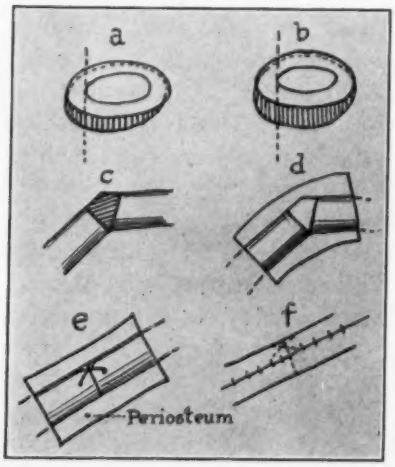

FIG. 1

a. Line drawing of simple bone wedge.

b. Line drawing of compound bone wedge.

c. Line drawing of angular deformity with metal pattern of wedge in place.

d. Line drawing of angular deformity, outline of wedge to be removed marked on cortex. Holes drilled for placement of kangaroo tendon.

e. Line drawing illustrating correction of angulation after removal of wedge. Kangaroo tendon placed subperiosteally through cortex to retain position.

f. Periosteum sutured in place over kangaroo tendon after correction of deformity.

levels, the correction of curvature or angulation is accompanied by equal or increased length instead of shortening as might be assumed.

After the line drawings have been altered to the most nearly normal weight-bearing line, measurements can be made from a point easily determined within the operative field. The shape of the wedge can be cut out of a thin piece of lead. At the time of operation a flexible steel ruler may be used to make the measurements on bone which has been exposed by reflection of the periosteum. The piece of sterilized lead is then molded around the diaphysis at the predetermined level (Fig. 1*c*), the proximal side usually forming an angle of ninety degrees with the longitudinal axis of the diaphysis. The outline of this pattern is then inscribed on the cortex with an osteotome or other sharp instrument (Fig. 1*d*). A bone saw rapidly follows the lines at the predetermined angle and the bone wedge is easily removed. Not infrequently it may be indicated to take the following precaution to secure fixation in alignment after the wedge is removed.

After the outline of the wedge has been inscribed on the cortex, a hole may be drilled through lateral and medial cortex, one centimeter from the proximal end of the distal fragment (Fig. 1*d*). Subsequent to the removal of the wedge a kangaroo tendon is passed through these holes and made to form an *X* on the anterior surface (Fig. 1*e*).

The reflected periosteum is then placed in position and sutured with interrupted black A silk sutures. The overlying structures are brought into apposition and sutured in a similar manner (Fig. 1*f*).

Figures 2*A* to 4*F* illustrate E. Y., a girl, age five years, with rachitic deformities of both lower extremities. *Irradiated Ergosterol, two one-hundredths of a milligram per day, given by mouth in olive oil, caused elevation of the inorganic phosphorus of the serum in four days; to the x-ray slight evidence of calcification in six days; and considerable progress in healing within a month. The curvature of the tibiae reveal the typical characteristics of deformities due to this cause in that:—(1) the anterior convexity extended throughout the

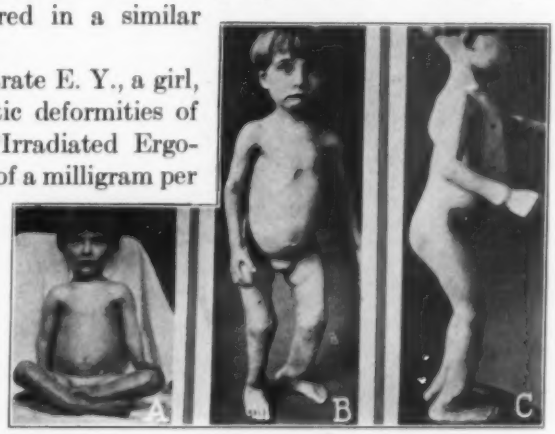

FIG. 2

A. Photograph of E. Y. Patient sitting with legs crossed, illustrating the mechanism of production of deformities.

B. and *C*. Photographs of E. Y., girl age five years, with rachitic deformities of both tibiae. Anterior convexity of distal half with lateral convexity in distal third, accompanied by rotation. Bilateral knock-knee.

*I am indebted to Dr. Samuel W. Clausen for the information pertaining to the use of Ergosterol.

distal half; (2) the lateral convexity was confined to the distal third; and (3) there was an accompanying internal rotation in the distal half. These abnormalities were of marked degree on both sides, most accentuated on the right and accompanied by bilateral knock-knee. Figure 2*A* illustrates the mechanism of production of these deformities during the acute stage, and emphasizes the prophylactic measures indicated to prevent the development of such curvatures and the subsequent necessity of operation for their correction. Figures 3*A* and *B* reveal the osseous deformities in the anterior-posterior and lateral x-ray views before correction. Figures 3*C* and *D* illustrate the tracings and pre-operative determination of location and shape of wedges necessary for the correction of the prevailing deformities. It will be observed that these deformities are illustrative of the type wherein the extent of diaphyseal involvement makes necessary the sectioning of the tibia in two places for correction of the anterior convexity. The distal wedge, compound in character, because of its anterior base extending to the

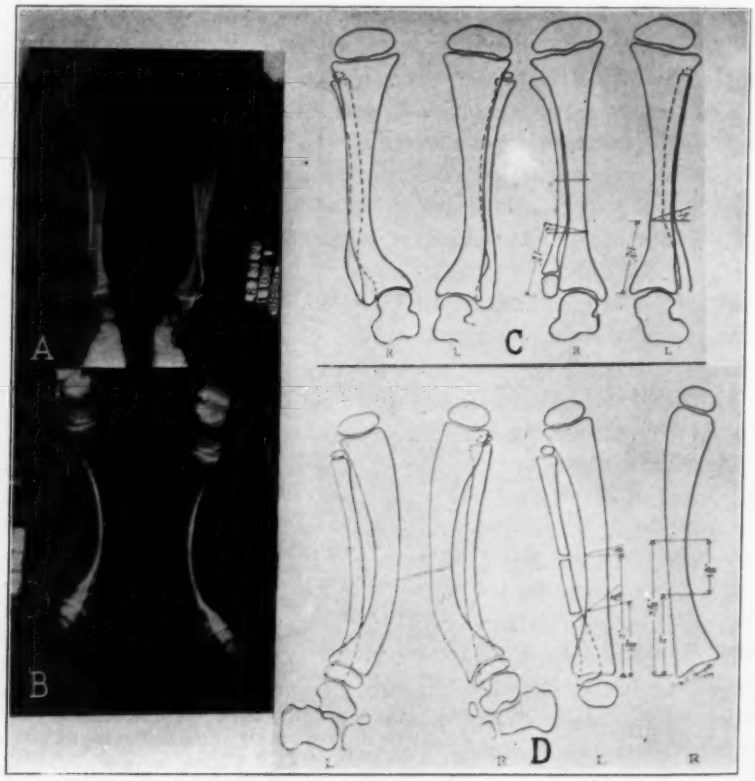

FIG. 3

A. and *B*. Anterior-posterior and lateral x-ray views of osseous deformities in both tibiae before correction.

C. and *D*. Tracing of right and left tibia in the anterior-posterior and lateral views of tibiae; the pre-operative determination of location and shape of wedge necessary for the correction.

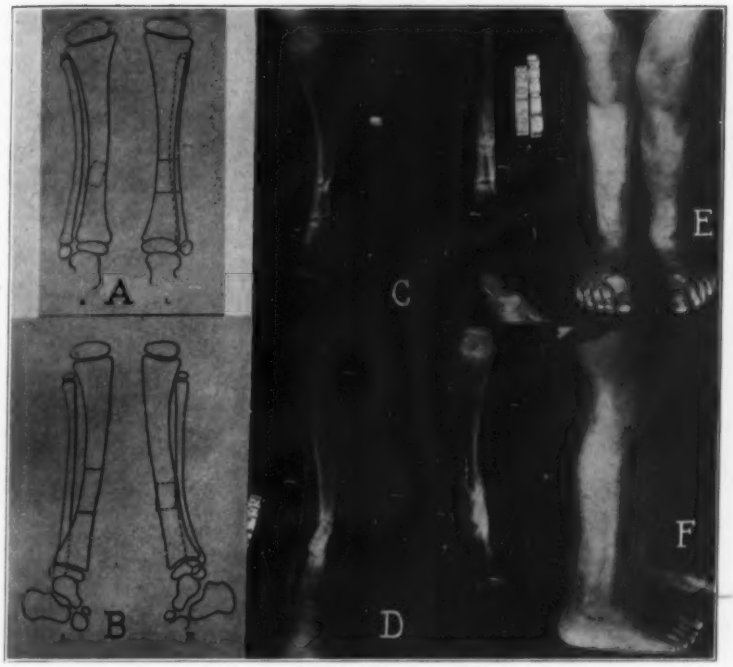

FIG. 4

A. and *B.* Tracing of x-ray negatives one week after operation.
C. and *D.* Anterior-posterior and lateral x-ray views of tibiae seven months after operation.
E. and *F.* Photographs of E. Y., seven months after operation on each tibia and fibula. Front and side views.

lateral side, provided for correction of both the anterior and lateral convexity in the distal third of each tibia. It should be further emphasized that the fibula may furnish definite obstruction to correction, even in the presence of accurate removal of tibial wedges, in the event that an insufficient amount of bone is removed; in this instance the opposing ends form a fulcrum which prevents placing the tibial fragments in close apposition. The minor rôle of the fibula as a supporting structure in the lower extremity justifies the lack of consideration given to the correction of its angulation; enough bone should always be removed subperiosteally from its diaphysis to remove its influence as an obstruction to the correction of curvatures and angular deformities of the tibia.

Figures 4*C* and *D*, reveal the anterior-posterior and lateral x-ray views of the tibiae two months after operation. Light anaesthesia and movement of the right leg at the beginning of closure accounts for the angulation of the middle segment of the right tibia. Such angulation was prevented on the left by placement of subperiosteal kangaroo tendon sutures through the bone, as above described.

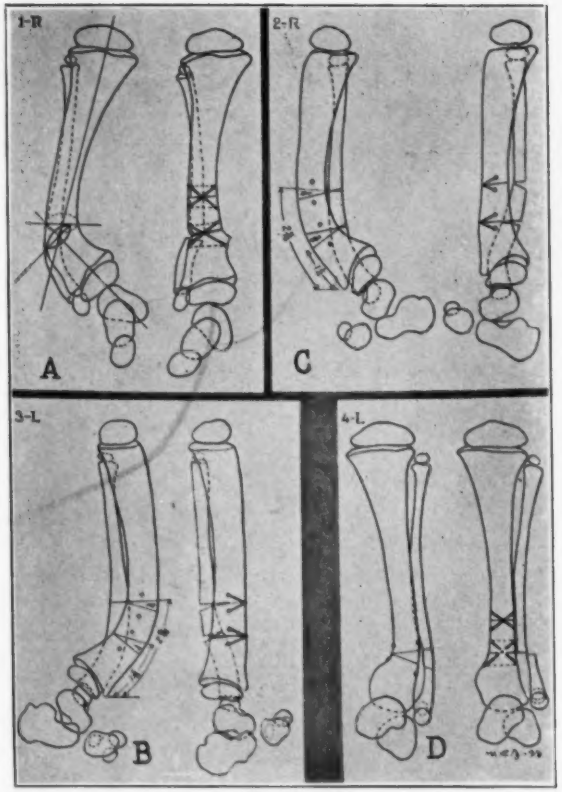

FIG. 5

A. and *B*. Tracings of anterior-posterior and lateral views of right tibia with pre-operative correction of rachitic deformities.

C. and *D*. Tracings of anterior-posterior and lateral views of right tibia with pre-operative correction of rachitic deformities.

FIG. 6

A. Lateral and anterior-posterior x-ray views of angular deformity following trauma to left femur, girl, age nineteen years.

B. Same views three weeks after operation.

Figure 5 illustrates the tracing of the anterior-posterior and lateral x-ray views of the rachitic deformities of each tibia; the patient was a boy, age seven years. The pre-operative determination and proposed corrections are also revealed. This case is too recent to report the end results.

Figures 6*A* and *B* illustrate an angular deformity following fracture of the left femur of a girl, age nineteen years. Ankylosis of the left knee, with sixty-five degrees of flexion deformity, resulted from an acute arthritis four years previous to traumatic posterior and lateral angulation of femoral condyles due to fracture through the metaphysis. Figures 7*A* and *B*, reveal the pre-operative determination of location and shape of wedge which should be removed to best correct the existing deformity. In Figure 7*C* is illustrated the reversed angulation resulting from attempting to correct the deformity at a higher level. This may be regarded as an excellent example of the fact that,—*for the maximum correction of a given angular deformity of a long bone there is an optimum point at which a wedge of given shape and size may be removed for this purpose.* Figure 7*D* reveals the post-operative result eight months after operation in both anterior and posterior planes. Two observations should be emphasized. (1) In this instance the wedge had to be removed subperiosteally through the junction of diaphysis with metaphysis. This made for the apposition of a small diaphyseal end on the condyles. Therefore, in order to prevent medial displacement, all bone was not removed from the medial side; the intact angular projection on the medial condyle remained to serve as a block against which the diaphyseal end was held in place by passing a kangaroo tendon suture through the ends of the lateral aspects of the

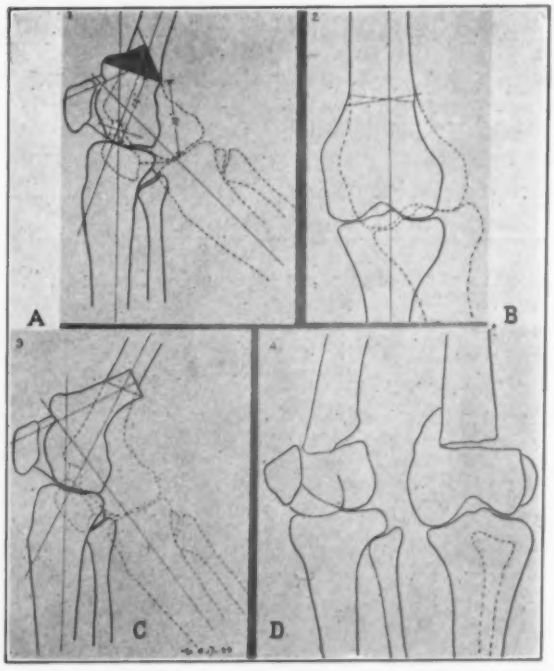

FIG. 7

A. Tracing of lateral view with pre-operative determination of procedure necessary for optimum correction of anterior angular deformity.

B. Tracing of anterior-posterior view with similar determination.

C. Tracing made of lateral view to reveal the deformity which would result from the removal of a wedge at a higher level, in the diaphysis.

D. Tracing of anterior-posterior and lateral views of left femur after correction of deformity by following the pre-operative determination in 7*A* and 7*B*.

two fragments. (2) These postoperative corrections can be traced and superimposed upon the pre-operative determination or vice versa. Attention should be called to the same possibility in the illustrations of previous cases.

SUMMARY

The correction of fixed angular and curved deformities of the long bones almost invariably requires a solution of continuity.

Osteoclasis has been supplanted by open reduction, which makes it possible to approach these problems by methods of precision.

The method described emphasizes that decisions made at the operating table relative to the level and shape of section to be made for the correction of a given deformity are not reliable.

This is true because it has been graphically demonstrated that there is only one level and section of given shape which will result in the maximum correction of a given deformity.

By this method the possibility of inducing other deformities is avoided.

CONCLUSION

Pre-operative determination of the level and shape of section to be removed is therefore necessary for the greatest assurance of the most desirable end result from operation for the correction of angular and curved deformities in the long bones.

I wish to express my appreciation to Mr. N. C. Jacobs for the drawings accompanying this article.

At the meeting of the **Pacific Northwest Orthopaedic Association,** held in Seattle on September 29, the program was of unusual interest. The presentation of cases, most of them with x-ray findings, was so interesting and many of the cases so unusual that two of the members of the Advisory Editorial Staff who were present suggested that the cases be reported in *The Journal of Bone and Joint Surgery*. The *Journal* is, therefore, indebted to these members of its Advisory Staff for the case reports given below.—*Editor.*

REPORT ON SHELF OPERATION FOR IRREDUCIBLE HIP DISLOCATION

BY C. F. EIKENBARY, M.D., SEATTLE, WASH.

R. Y.: Female, age twenty-one. Congenital dislocation of both hips. Patient was operated upon when she was about four or five years old. Both hips were then reduced but later on both hips had slipped. Her disability was becoming rather marked and, therefore, a shelf operation was decided upon, which was done on April 27, 1928. The accompanying pictures, taken on August 24, 1928, show the enormous shelf that has resulted from the operation. At the time of operation, not only were small fragments turned down from the side of the ilium, but almost the entire mass of the anterior portion of the ilium was turned down as well.

FIG. 1

FIG. 2

SUCCESSFUL TRANSPLANT OF TIBIA AFTER CONTAMINATION WITH DIRT AND PERSPIRATION

BY ROGER ANDERSON, M.D., SEATTLE, WASH.

Patient was a motorcycle policeman who was in an accident on August 19, 1928, and received a compound fracture of the right leg. The fracture was very unusual in that a piece of tibia four inches long with fairly square edges was extruded through an inch and a half laceration on the leg and lay absolutely loose in the patient's underwear. On entering the hospital the clothes were cut off the leg and raised up and this piece of tibia remained in the clothing. There was not a single piece of muscle or fibrous tissue connected with this piece of tibia and it looked as if it had been scraped with a knife. The loose fragment was in one piece and not comminuted at all. There were many compounded wounds in the leg but none of them over an inch and a half in length.

In considering the treatment, the question came up as to what could be done with this piece of tibia. It was visibly and grossly contaminated, and had been exposed to

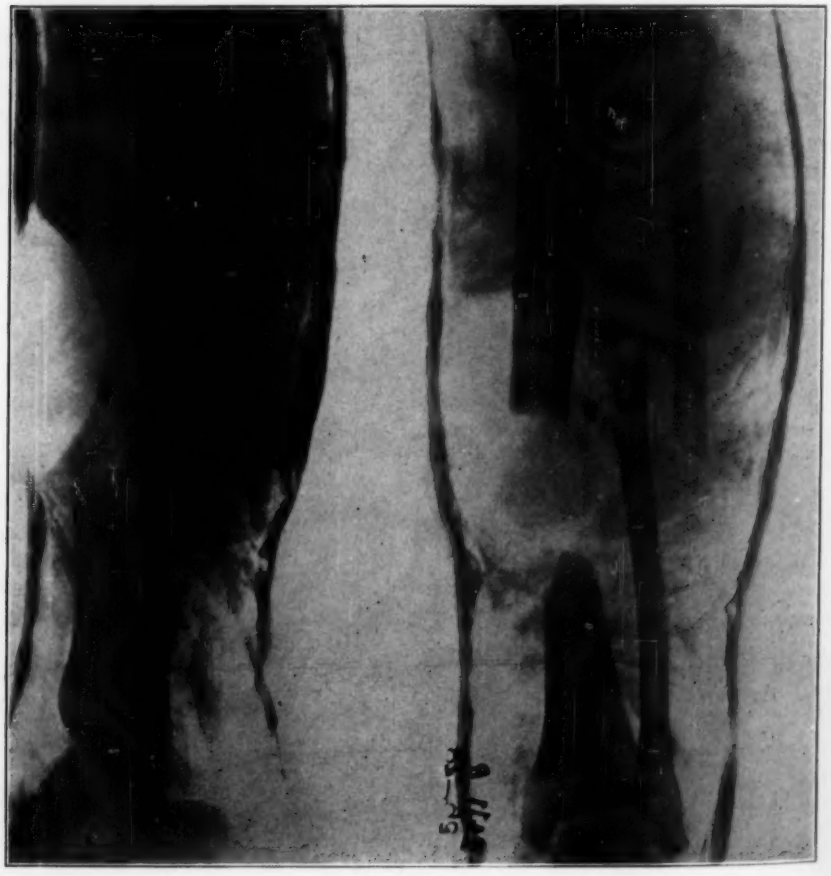

FIG. 1

the air for nearly an hour. It was decided to try to utilize this piece of tibia for future transplants to fill the large gap in the tibia. It was washed off with water and then iodin was poured over it. It was then put on a sterile table, and by means of saw and chisel it was sliced so that it looked like pieces of bacon. These fragments with the medullary canal were buried in the muscular tissue in a continuous non-injured spot on the lateral aspect of this same leg and these wounds were sutured without drainage. Meanwhile the compounded wound had been debrided and closed without drainage and the leg put in a cast. There was a small slough over one of the compounded areas which was completely healed in about three weeks. The recovery was uneventful otherwise.

The last x-rays show that the transferred pieces of tibia are viable. There has been no separation at all from the area where the tibial fragments were buried. Sufficient time has now elapsed and the patient will be operated on. The fibula will be transplanted into the tibia in a two-stage operation and the buried tibial transplants will be placed around the fibula graft to reenforce it.

AN UNUSUAL CONDITION OF THE ELBOW JOINT

BY D. A. MURRAY, M.D., SEATTLE, WASH.

This is an interesting condition recently observed in an elbow joint.

Twelve years ago the patient suffered from an affection of his right elbow joint. He was treated by the late Dr. Fassett and it is stated that a diagnosis of tuberculosis of the elbow joint was made. The arm was placed in a plaster-of-Paris cast for almost a year, and the patient states that upon the removal of the cast, the elbow joint was stiff. Later, he had various forms of treatment of an indefinite nature. An examination of the x-rays taken twelve years ago would seem to confirm the diagnosis made by Dr. Fassett at that time. In any event it was a destructive lesion of the lower end of the humerus of long standing.

The condition at the present time is interesting as the x-ray film shows. The man is employed as a layer of tile floors and the range of movement in the joint is fairly good. If the range of motion of the normal elbow joint is regarded as one to one hundred, the movement in this joint could be regarded as being between thirty and eighty. The lower articular surface of the humerus has been almost completely destroyed and the

FIG. 1

Anteroposterior view of right elbow, April 29, 1919.

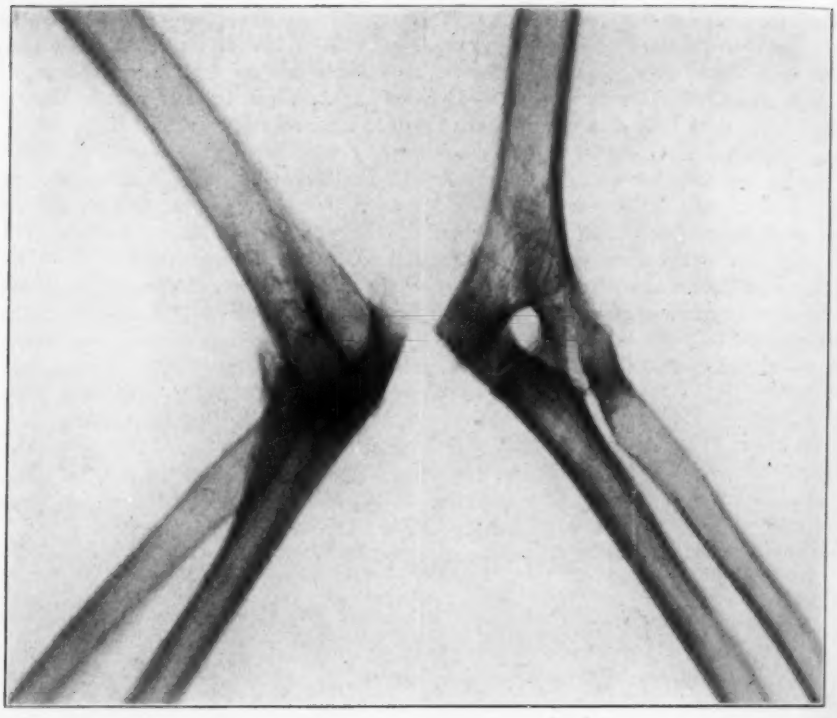

FIG. 2
The same elbow joint in May 1928

upper end of the ulna fits into a notch which is left. Complete extension of the elbow is limited by the ulna coming in contact with the posterior surface of the humerus and flexion of the elbow is limited by the upper end of the radius coming in contact with the anterior surface of the humerus. The arm is now fairly useful and although it is somewhat smaller than the other arm the range of movement is surprisingly good.

A study of this elbow joint would seem to emphasize the opinion held by many that great accuracy is not necessary in shaping the bone ends in arthroplasty of the elbow joint.

FINAL RESULT AFTER OPERATION BY BONE GRAFT FOR BONE CYST

BY MITCHELL LANGWORTHY, M.D., SPOKANE, WASH.

CASE HISTORY: Twelve-year-old boy, healthy, with injury to right arm, as shown in the x-ray pictures. Diagnosis was made of pathological fracture through the region of a large bone cyst.

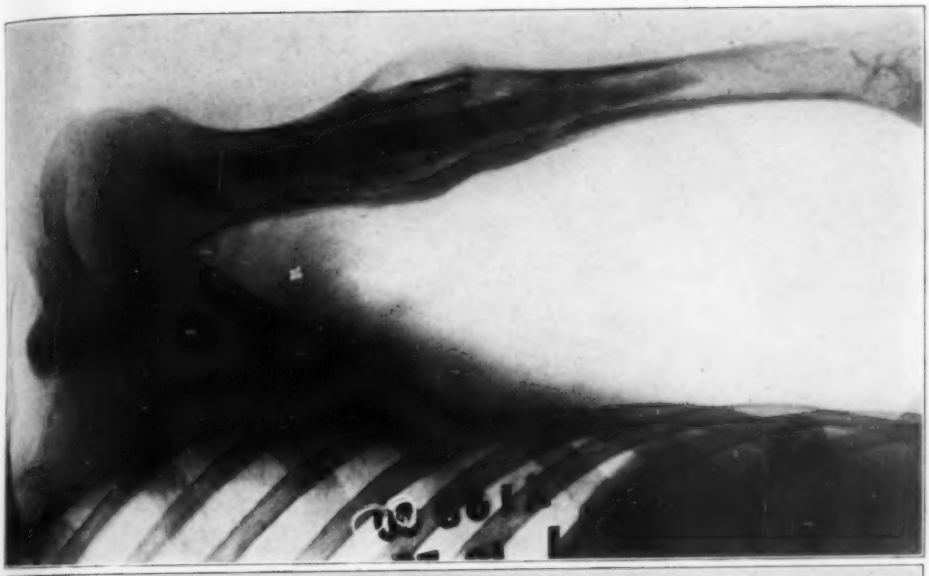

FIG. 3

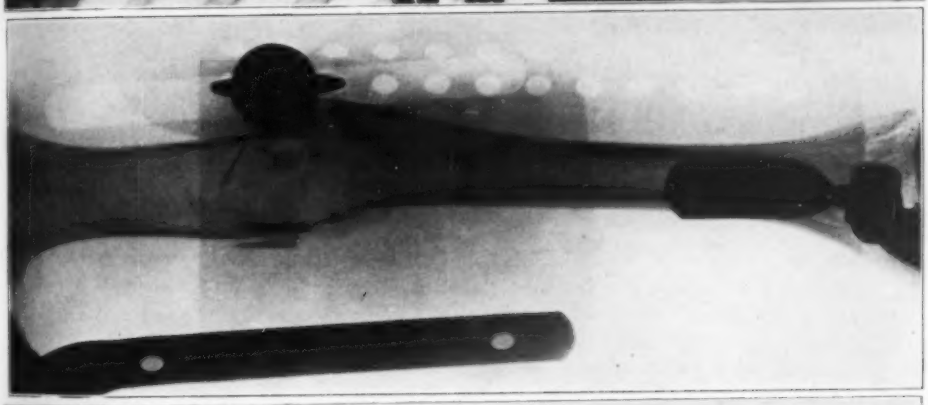

FIG. 2

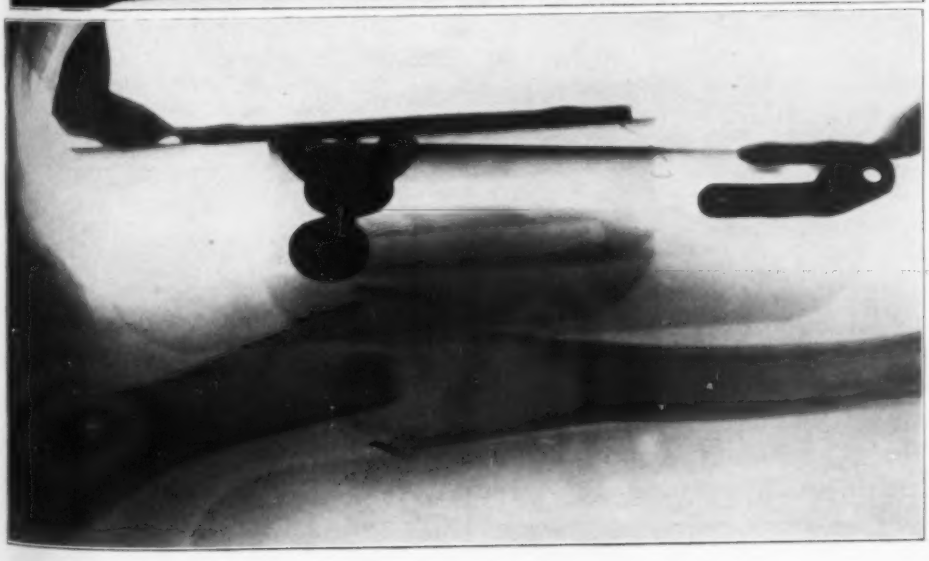

FIG. 1

FIG. 4

FIG. 5

This boy had been treated just two years before for a fracture in the same region and the x-ray pictures at that time showed a little rarefaction in the fractured part of the humerus. Following the first injury he made a good recovery with conservative treatment.

The condition now presented so much rarefaction and bone destruction that a bone graft with a crushing down of the humerus all around the graft was decided upon, in order to secure as complete an obliteration of the cystic process and as firm union as possible, so that further fractures would not occur.

This operation was done, and a long graft removed from the tibia and used as an intramedullary peg around which the humerus was collapsed and telescoped, following a thorough cleaning out of the cyst.

This patient has gone ahead to a very excellent result, as shown in the last x-ray pictures and in the photographs which show function. The arm is perfectly strong and useful in every way, although of course the humerus is somewhat shortened.

FIBULAR TRANSPLANT

BY EDWARD A. RICH, M.D., TACOMA, WASH.

Occasionally one is called upon to compensate a tibial defect by transplanting the fibula. The case shown illustrates the possible lengthening of the leg; is well done mechanically, and has good function.

CASE: T. T., aged eleven. Acute multiple osteomyelitis, May 1926, involving left tibia and left ilium. Sequestrum of entire shaft of tibia, some seven inches long was removed in July 1926. General condition of boy was very poor. Involved area in ilium was incised and treated, but not pertinent in this report. Orr's "pack and let alone"

FIG. 1

treatment was used in both areas, with complete healing in pelvis in two years, and in leg in twenty-six weeks.

Transplantation of small fibula was done by two-step method. Upper end was transplanted into a packed grave in the proximal remnant of tibia, July 23, 1928. Care was taken to strip the periosteum from the shaft, leaving it attached to original site

FIG. 2

about the fibular head and low on the shaft. Shaft was cut near enough the head to allow nearly an inch lengthening.

On August 16, 1928, in like manner, the lower end of the fibula was transplanted.

In both instances healing was prompt. Fully two inches was gained in length after allowing for some growth and some absorption from pressure.

Knee action was never interfered with. Ankle motion was about half normal.

In three and a half months the boy walked in lateral brace (shoe to thigh), and shortly afterwards discarded sticks. The appearance, axis, and function of leg are almost perfectly restored.

TUBERCULOSIS OF SYMPHYSIS PUBIS

BY H. C. BLAIR, M.D., PORTLAND, OREGON

This case is of interest for two reasons: first, because tuberculosis of the symphysis pubis is comparatively rare, and secondly, the method of treatment, so far as the writer has discovered, is unique.

The patient was first seen in our clinic May 25, 1925, at which time she had noticed a lump in the left groin for about six months. She had had tuberculosis of the lungs

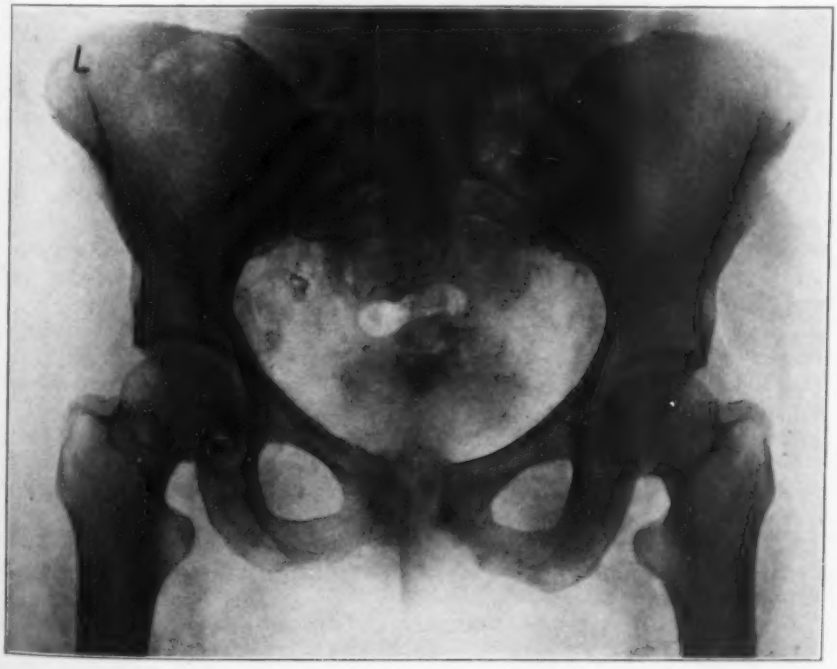

FIG. 1

X-ray taken November, 1927. Shows destruction of bone at the symphysis with a small sequestrum.

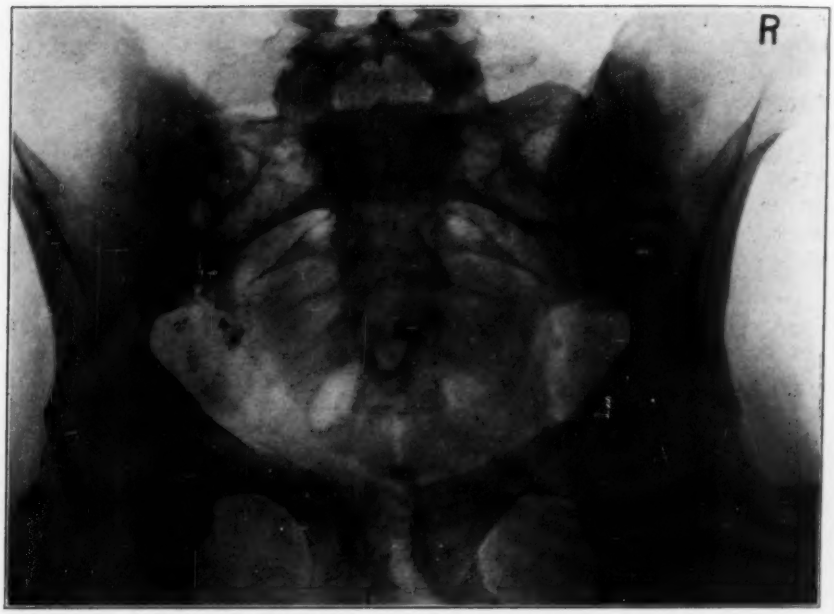

FIG. 2

X-ray taken January 10, 1929. Shows a bridge of bone at the symphysis.

and of the glands of the neck twelve years before, at which time the glands were removed surgically.

Physical examination at the time of the first examination revealed a scar of the neck, and the left labium was markedly enlarged, reddened, and some fluctuation was present. The routine urine, blood, and Wassermann tests were negative.

It was suspected at first that a Bartholinian cyst or abscess was present. An operation at that time by Dr. Joyce revealed a tuberculous mass which extended into the symphysis pubis, and two small sequestra were removed. The wound was cleaned and sutured without drainage. Microscopic examination in the pathologic laboratory at the University of Oregon Medical School revealed that the tissue removed was tuberculous.

X-rays taken revealed a marked separation of the symphysis, also considerable destruction of bone on both sides. The patient complained of pain referable to the left sacro-iliac joint, which was associated with some sciatica. She was then treated in bed with plaster spicas for two years, any ambulation causing severe pain.

At the end of that time it was decided to fuse both sacro-iliac joints, the idea being that the fusion would prevent movement in the symphysis and at the same time stabilize the sacro-iliac joints. The left side was done March 25, 1927, by Dr. Joyce and the author; the right, April 26, 1927. The Smith-Petersen technique was used.

After two months the patient was allowed to be up, wearing a girdle, and since that time has remained remarkably well. A sinus in the region of the symphysis present at the time of the operation, has now closed.

X-rays reveal new bone deposit in the symphysis and the patient is able to walk as far as two miles a day.

NATURAL REPAIR IN EXTENSIVE COMPLICATIONS OF LEG FRACTURES

BY CHARLES R. McCLURE, M.D., PORTLAND, OREGON

Man had suffered simple fracture of both bones of the leg. Non-union resulting, he had a bone-grafting operation on the tibia by another surgeon. Operative infection, loss of graft and extensive osteomyelitis followed. When he came under the observation of the writer, this condition and absolute non-union were still present.

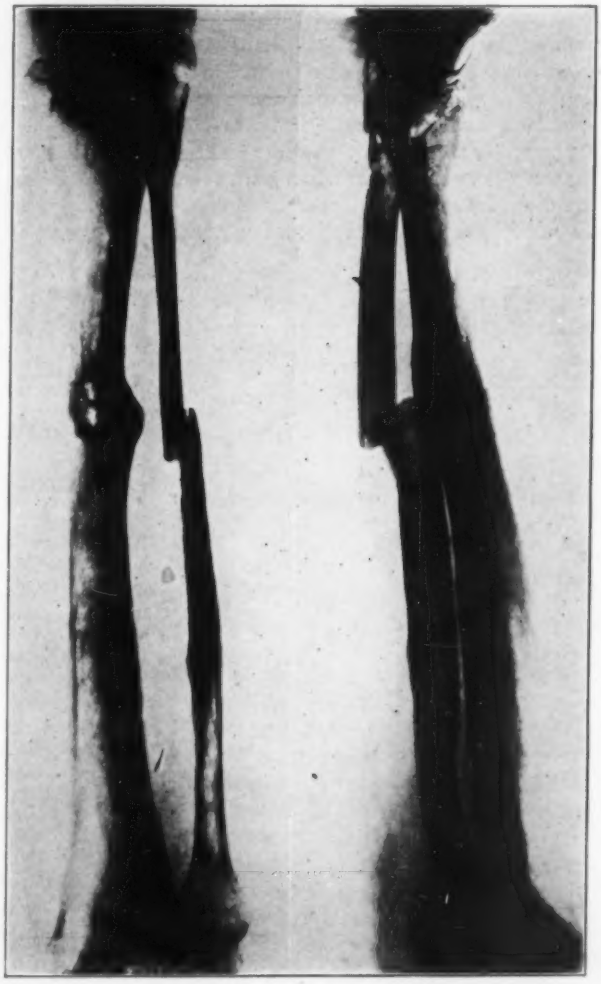

FIG. 1

Taken eight months after operation. Shows restoration of tibia and union at site of tibial fracture.

The Orr method of treatment was then carried out. The tibia was widely guttered for its full length and packed with vaselin gauze; cast was applied from toes to groin. The net result was complete solid healing of the bone, with clinical union of the fracture. Man is now walking without artificial support.

Radiographs show complete restoration of the tibia with solid union at site of the fracture.

FEMORAL REGENERATION IN CHILD

BY R. L. JEFFERY, M.D., SEATTLE, WASH.

Baby S., age fourteen months. At birth the child sustained an epiphyseal separation at the lower end of the femur. The epiphysis was dislocated outward and pulled upward slightly. Numerous attempts were made to reduce this dislocation at various times and by various men during the first ten days. All these attempts failed and it was a question whether to attempt a reduction by open operation. It was finally decided to delay this procedure for a time because of the patient's age and because it was thought possible that regeneration might take place naturally.

The leg was placed in a splint for five weeks pulling the tibia and femur into correct alignment. Various x-rays have been taken since that time; and after three months it was decided to discard all thought of operative interference.

At the present time, as can be seen by a fairly recent radiogram, a new femur has

FIG. 1

FIG. 2

FIG. 3

FIG. 4

virtually been formed and the lower half of the original femur has been practically absorbed. It will be noticed that the regeneration is practically perfect, even to the epiphysis markings which correspond identically with those of the opposite side.

One of the reasons for this remarkable regeneration is probably the fact that there must have been a stripping of the periosteum away from the femoral shaft when the epiphysis was displaced, the lower end of the stripped periosteum remaining attached to the epiphysis. This deduction is made because of the rapidity of callus formation, even high up on the femur.

This child has been examined at various times and little if any shortening has been demonstrated at any time. Measurements of the radiograms show less than one-fourth of an inch shortening on the affected side. There is a slight enlargement of the internal condyle on the affected side. The child is now walking and shows no perceptible limp.

This case is presented to show the tremendous possibilities in infants of bone regeneration and accommodation to what appear to be insurmountable obstacles.

CLARENCE LESLIE STARR

Clarence Leslie Starr, M.D., LL.D., born July 1, 1868, died on December 25, 1928. The passing of this distinguished man has come as a surprise and shock to all who knew him.

He was the son of a country doctor and from his earliest childhood was keenly interested in the treatment of the sick. The experience of these early years left a deep impression on him which showed itself constantly in his attitude towards patients and in the ideals which he endeavored to inculcate in his students.

He was graduated with honors from the Medical School in Toronto in 1890. He then spent a year and a half as house-surgeon at the Hospital for Ruptured and Crippled in New York under the tutelage of Wm. T. Bull and Virgil P. Gibney. During this period he received the degree of M.D. at Bellevue Hospital Medical School. From New York he went to England and Germany where he studied with Howard Marsh, D'Arcy Power, John Caird, and Hoffa.

Upon his return to Toronto in 1894 he was appointed to the staffs of the General Hospital and the Hospital for Sick Children. In the former he engaged in general surgery but in the latter he limited himself at first to the surgery of deformities.

In 1911, he was appointed Surgeon-in-Chief at the Hospital for Sick Children and was given the task of reorganizing the surgical staff. This gave him his first opportunity to demonstrate his remarkable ability as an organizer and administrator. By slow degrees he surrounded himself with young men, trained in both general and orthopaedic surgery, each of whom he considered capable of succeeding ultimately to the post of surgeon-in-chief. He had no patience with a system which, for the sake of getting the day's work done, fills hospital appointments with men of poor abilities who cannot be expected to compete for ultimate advancement. Such a high standard means, of course, that the staff must be small and probably work very hard, but for young men he considered this no disadvantage.

The outbreak of the War brought further opportunity for service. During 1914 and 1915 he was left almost alone at the Children's Hospital, owing to the departure of the younger members of the staff to France. In addition to this increased work he was engaged in the preparations for the care of returning wounded soldiers. In 1916, with the recall of two of his staff at the Children's Hospital, he went overseas with the rank of Lieutenant-Colonel and took charge of the surgical service at the Granville Canadian Special Hospital. Here he rendered service of the highest order for which he was mentioned in dispatches. Towards the end of 1917 he was recalled to Canada with the appointment of Chief Consultant in Orthopaedic Surgery. This appointment entailed constant traveling from the Atlantic to the Pacific with stops at the numerous hospitals established across the Dominion. To his excellent organizing ability and to his expert surgical judgment is due much of the success of the rehabilitation of wounded Canadian soldiers.

In 1921 he was called to the chair of Surgery in the University of Toronto and to the post of Surgeon-in-Chief at the Toronto General Hospital. Here the lessons he had learned at the Children's Hospital stood him in good stead, and he began the same slow process of building up the staff from the bottom. This process is nearly completed, but unfortunately Dr. Starr did not live to enjoy the contemplative satisfaction which is the reward of work well done.

In these days of the development of specialties in general surgery, the career of this distinguished man merits more than passing consideration. He understood as well as any the importance of orthopaedic surgery and his contributions to its developments place him among its most distinguished students. He believed, however, that the general surgeon, specially trained, was in the majority of instances more competent to deal with the surgery of deformities than the specialist pure and simple. He had no sympathy with the present-day tendency for young men, just out of internships, to confine themselves to any special branch of the art.

CLARENCE LESLIE STARR

During his career he had many high honors bestowed upon him. In 1913 he was made an LL.D. of McMaster University. In 1920 he was President of the American Orthopaedic Association, and in 1928 Vice President of the American Surgical Society. In 1924 he temporarily occupied the chair of the Professor of Surgery at Harvard Medical School, in substitution for Professor Harvey Cushing. Just before his death he received a similar temporary appointment to the chair at St. Bartholomew's Hospital in London. He was a member of the Canadian and American Societies of Clinical Surgeons and an honorary member of the British Orthopaedic Association.

In the death of Clarence Starr, surgery has lost a brilliant teacher, an organizer and administrator of rare ability, and a master surgeon. On his students he left a lasting impress of his strong personality. As an organizer he always brought order out of chaos and laid the foundations for sound progress. As a surgeon he was a keen diagnostician and a skilful operator and his judgment invariably inspired the admiration of his colleagues. He will be remembered chiefly, however, for the attraction he exerted upon young men and for his rare gift for arousing in them a consuming love of their art.

News Notes

At the invitation of the **British Orthopaedic Association**, the **Annual Meeting of the American Orthopaedic Association** will be held this year in England, with the British Association. The dates of this joint meeting are July 3, 4, 5, and 6. Most of the members of the American Orthopaedic Association who are planning to attend will sail from New York on the Transylvania, on June 22.

For the convenience of these members, as well as for others who may not be able to make the trip abroad, it has been planned to have a Clinical Day in New York on June 21. The sessions will be held at the Hospital for the Ruptured and Crippled. As tentatively outlined by the Program Committee, the plans for the Clinical Day include the following:

Morning Session, 9 o'clock

Reconstruction Operation on the Hip for Legg-Perthes' Disease.
Dr. Royal Whitman

Demonstration of the Treatment of Anteversion in Congenital Dislocation of the Hip.
Dr. Arthur Krida

Fusion of the Hip for Tuberculosis.
Dr. Alan deForest Smith

Cases Illustrating Final Results in Suppurative Arthritis.
Dr. P. W. Nathan

Operation for Recurrent Dislocation of the Shoulder.
Dr. Toufick Nicola

Fracture of the Neck of the Femur in Children. Dr. Paul Colonna

Cases Illustrating Reconstruction Operations on the Foot and Hand.
Dr. Leo Mayer

Cases of Myofascitis. Dr. S. Oscar Fry

Stenosing Tendovaginitis at the Radial Styloid Process.
Dr. Harry Finkelstein

Vaccine Therapy for Arthritis. Dr. Russel Cecil

Cases Illustrating the Neurosurgical Significance of Backache.
Dr. Charles Elsberg

Case Illustrating the Operative Correction of Chronic Subluxation of the Sternoclavicular Joint. Dr. Henry H. Kessler

Afternoon Session, 2 o'clock

Multiple Metastatic Sarcoma of Bone and Soft Parts. Well three years after toxin treatment. Dr. William B. Coley

Clinical Results with Ultraviolet Irradiation and Irradiated Foods and Sterols.
Dr. Alfred F. Hess

Cases Illustrating the Injection Treatment of Varicose Veins.
Dr. Isidor S. Tunick

Cases of Osteomyelitis Treated by the Orr Method.
Dr. Ralph C. Kahle

Spine Fusion by Tibial Bone Graft for Spondylolisthesis.
Dr. Elmer P. Weigel

Cases of Vertebral Epiphysitis. Dr. Joseph Buchman

Rotation Exercises for Scoliosis; a Clinical Demonstration.
Dr. Walter Truslow

Cases of Scoliosis Showing the Advantages of Rib Resection.
Dr. Armitage Whitman

Cases of Structural Scoliosis Operated More Than Five Years Ago.
Dr. S. Kleinberg

Exhibit Demonstrating Results Obtained in the Curative Workshop.
Dr. Frederick G. Elton

The program of the joint meeting is being arranged by Mr. A. S. B. Bankart, Honorary Secretary of the British Orthopaedic Association, and Dr. Ellis Jones, Chairman of the Program Committee of the American Orthopaedic Association. The preliminary program is as follows:

July 3, 1929, Liverpool

Clinical Day with Sir Robert Jones.

July 4, 1929, London

Morning Session

The Treatment of Fractures of the Neck of the Femur with Special Reference to the End Results.
Mr. E. W. Hey Groves, Bristol
Dr. Royal Whitman, New York City

Afternoon Session

Operations and Clinical Meeting.

July 5, 1929, London

Morning Session

Reconstructive Surgery in Paralytic Deformities of the Lower Leg.
Dr. Melvin S. Henderson, Rochester, Minnesota
(Contributor from British Orthopaedic Association to be selected.)

Afternoon Session

Operations and Clinical Meeting.

Evening

Association Dinner.

July 6, 1929, Alton

The Treatment of Disabilities Resulting from Low Back Derangement.
Dr. Elliott G. Brackett, Boston, Massachusetts

Defects in Modern Antiseptic Methods as Applied Especially to Infections of Bones and Joints. Dr. H. Winnett Orr, Lincoln, Nebraska

The Present Status of Arthroplasty. Dr. William S. Baer, Baltimore, Maryland

End Results in Bone Block Operation for Drop-foot. To be illustrated by motion pictures. Dr. Willis C. Campbell, Memphis, Tennessee

Compensation Treatment of Scoliosis. Dr. Arthur Steindler, Iowa City, Iowa

Pre-hallux (accessory scaphoid) as a Cause of Flat-foot; Operative Correction.
Dr. Frederick C. Kidner, Detroit, Michigan

Dr. John L. Porter and Dr. Robert C. Lonergan recently announced the opening of a gymnasium and laboratory for the treatment of patients requiring muscle reeducation, corrective gymnastics, massage, and physical therapy. Their new office suite is located at 636 Church Street, Evanston, Ill.

Dr. Mayer S. DeRoy has been appointed to the Assistant Staff of the Presbyterian and St. Francis Hospitals, Pittsburgh, Pa., on the Service of Dr. C. C. Yount.

Dr. Arthur Steindler, Professor of Orthopaedic Surgery at the State University of Iowa and a member of the Advisory Editorial Staff of the *Journal*, has recently been elected an honorary member of the Belgium Surgical Society.

Dr. C. C. Yount gave a short course in Orthopaedic Surgery to the Washington County Medical Society at Washington, Pa., on January 25. This course was part of a general post-graduate course for county societies being conducted by the Medical Faculty of the University of Pittsburgh.

Many of the readers of the *Journal*, are planning to attend the annual meeting of the **American Medical Association** to be held in Portland, Ore., July 8 to 12. The papers for the Orthopaedic Section will be presented on the mornings of the third, fourth and fifth days of the meeting, July 10, 11, 12.

The American Interurban Orthopaedic Club is to be congratulated in having for its President Dr. John L. Porter, of Evanston, Ill. The first meeting under his presidency was held in Memphis on March 29 and 30, at the clinic of Dr. Willis C. Campbell. A report of the meeting will appear in the next issue of the *Journal*.

At a meeting of the orthopaedic surgeons of the City of Milwaukee, held at the home of Dr. F. J. Gaenslen in December 1928, the **Milwaukee Orthopaedic Club** was formed. Dr. F. J. Gaenslen was chosen President, and Dr. J. O. Dieterle Secretary and Treasurer. The membership includes the following: Dr. F. J. Gaenslen, Dr. H. C. Schumm, Dr. L. D. Smith, Dr. H. W. Powers, Dr. C. C. Schneider, Dr. J. O. Dieterle.

A guide book for physicians and medical students who intend to visit Hungary is being distributed gratis by the Cunard Line. It gives full information concerning the conditions under which members of the medical profession may continue their studies in Budapest, giving courses which may be taken up at the various clinics and universities. The book may be obtained by application to the Cunard Line, 25 Broadway, New York.

Readers of the *Journal* who are to be in Europe this summer may wish to attend the **World Conference on the Cripple,** which is to be held in Geneva from July 29 to August 4. Dr. Paul H. King, 428 Buhl Building, Detroit, Michigan, is chairman of the committee in charge.

The Istituto Ortopedico Rizzoli in Bologna announces the competition for the prize Umberto I. This prize of 3500 lire will be assigned, according to the decision of the Provincial Council of Bologna, for "the best orthopaedic work or invention."

Italian and foreign doctors may take part in this competition. The arrangement of the competition and the awarding of the prize is fixed by the regulations which will be sent to whoever asks for them.

Application for the competition should be made to the President of the Rizzoli Institute, Bologna, Italy. The competition will close December 31, 1929.

The **Michigan Orthopaedic Society** was recently organized in Detroit. The charter members include the following: Dr. Carl Badgley, Ann Arbor; Dr. John Hodgen, Grand Rapids; and Dr. W. C. Blodgett, Dr. F. E. Curtis, Dr. R. V. Funsten, Dr. A. G. Goetz, Dr. F. C. Kidner, Dr. A. D. LaFerte, Dr. Frank H. Purcell, and Dr. D. M. Stiefel, of Detroit.

Dr. LaFerte was elected President, Dr. Funston Vice-president, and Dr. Curtis Secretary for the year 1929. Membership is limited to surgeons who spend full time in orthopaedic work. The purpose of the organization is the drafting of policies in matters relating to orthopaedic surgery and the care of the crippled child, and for the transaction of any other business pertaining to orthopaedic surgery.

The first meeting of the **Pan-American Medical Association** was held in Havana, Cuba, December 29 to January 3. Dr. Fred Albee of New York, one of the founders, was also the first President. Dr. Behrens and Dr. Ferrer of New York were the Secretaries. Dr. F. M. Fernandez, of Havana, "Secretario de Sanidad y Beneficencia" for Cuba, was most active in preparing for and largely responsible for the success of the meeting. Representatives from about ten of the Central and South American countries, in addition to those from Cuba and the United States, participated in the executive sessions and in the program. Dr. Fernandez was elected President for the ensuing year and Dr. R. A. Hurd, of New York, President-elect.

Dr. Alberto Inclan, of Havana, and Dr. H. Winnett Orr, of Lincoln, Neb., were the speakers upon subjects of interest to orthopaedic surgeons.

A meeting of the **Philadelphia Orthopaedic Club** was held at the Philadelphia Orthopaedic Hospital on Thursday, February 14, 1929. The following cases were presented:

Dr. Henry Pleasant, Jr., a case of sacro-iliac subluxation fifteen years after injury;

Dr. George Wagoner, a case of osteochondritis dissecans, hereditary influence (Pictures were exhibited of Etruscan bronze statuette showing dislocated hip, 350 B.C.);

Dr. W. J. Taylor, a case of lesion of pia, caused by varicose veins and a case of adhesions of cord producing spinal cord symptoms;

Dr. J. T. Rugh, a case of congenital dislocation of hip with confusing history;

Dr. A. Bruce Gill, treatment of fracture of neck of femur, and discussion of tuberculosis of hip mistaken for Perthes' disease;

Dr. DeForest P. Willard, a case of Shuerermann's disease, and a case of operation for wrist-drop following musculospiral injury;

Dr. James E. Wyant, a case of congenital absence of radius, and cases of bone block operation for foot-drop;

Dr. C. Howard Moore, a case of Kienbock's disease.

The December meeting of the **Chicago Orthopaedic Club** was held in conjunction with the Chicago Medical Society, at which time a paper, "Developmental Abnormalities of the Lumbosacral Region and Their Significance as a Cause of Pain and Disability" was read by Dr. Russell A. Hibbs of New York City. This was discussed by Dr. E. W. Ryerson, Dr. H. Potter, and Dr. P. Magnuson.

The January meeting consisted of a clinical program with cases presented by Dr. B. H. Moore, Dr. F. C. Test, Dr. R. O. Ritter, and Dr. F. A. Chandler. The following officers were elected: Dr. F. C. Test, President; Dr. R. O. Ritter, Vice-president; Dr. F. A. Chandler, Secretary-Treasurer.

At the February meeting a paper, "Fundamental Principles of Bone Pathology" was read by Dr. J. P. Simonds, Professor of Pathology at Northwestern University Medical School.

The **Minnesota Orthopaedic Club** met in the Twin Cities on November 30 and December 1, 1928. The first morning the meeting was held at the Twin City Unit of

the Shriners' Hospitals for Crippled Children, and consisted, first, of a one-hour clinic by Dr. Steindler, of Iowa City, on cases of infantile paralysis, septic arthritis and osteomyelitis, with a discussion of the various difficulties in diagnosis and treatment. An unusual case of congenital hypertrophy of the left side of the body, including the tongue, was shown, an interesting feature being that the calf on the opposite side was markedly enlarged and hardened, showing on biopsy a typical picture of pseudomuscular hypertrophy.

Following the clinic Dr. Steindler gave a two-hour talk on kinesiology, during which time he demonstrated the application to the locomotive system of the living body of the physical laws governing mass, inertia, and gravity. He showed that mathematical estimation of the "absolute muscle strength" can be made, and that the force required for the movement of limbs, or parts of limbs, about their various centers of rotation and the location of centers of gravity can be worked out. This study of gravity centers is quite essential to the proper understanding and treatment of postural pathology in all its phases. A knowledge of the primordial motions of various portions of the body and the amount of force required to produce motion about the various centers of rotation gives one an insight into the course of the restoration of power in temporarily paralyzed muscles, and also helps one to grade the exercises through which the muscle is put, so that an excessive strain is not placed upon the weakened muscle.

The second morning the meeting was held at the Gillette State Hospital for Crippled Children, the first hour being spent on a series of cases presented by Dr. Chatterton and Dr. Flagstad, with discussion by Dr. Steindler. Following this clinic Dr. Steindler talked on posture and scoliosis, bringing out the application of some of the various facts which had been mentioned on the previous day.

A meeting of the **Boston Orthopaedic Club** was held in Sprague Hall of the Boston Medical Library on the evening of December 10, 1928.

The first paper was by Dr. Harold C. Bean of Salem, who reviewed the literature of "Tuberculosis of the Symphysis Pubis" and reported a case which had been under his care. The paper was discussed by Drs. Painter, Wilson, Sever, Osgood, and Mark Rogers.

The second paper was by Dr. John Homans. He gave a careful analysis of the anatomy and physiology behind the formation of varicose veins, reviewed their symptomatology, and discussed their treatment. The paper was discussed by Drs. Brewster, Carroll, and Osgood.

The annual meeting of the Boston Orthopaedic Club was held in the Boston Medical Library on Monday evening, January 14. Dr. Charles F. Painter was elected President for the year and Dr. R. K. Ghormley, Secretary-Treasurer. Fifty members were present.

The first paper was by Dr. Smith-Petersen, who reported a series of cases of fracture of the neck of the femur treated by a new method. Dr. Smith-Petersen has devised a special nail with three flanges on it. In this manner he gets a great deal more friction surface of the nail without much displacement of bone, and it makes a very firm fixative material. He reported eighteen cases treated by this method, of which four failed, giving considerably better than seventy-five per cent. good results. Early function is possible, which stimulates bony union. The paper was discussed by Drs. Brackett, Osgood, Ridlon, and Allison.

The second paper was by Dr. John Kuhns. He reviewed the literature on lymphatics of the lower extremities and reported some experiments in which he injected India ink and other substances into the knee and ankle joints of rabbits. He found that drainage of the knee joint takes place into the iliac lymph glands and of the ankle joint into the popliteal and inguinal glands. The paper was discussed by Dr. Osgood and Dr. Freiberg.

A meeting of the Boston Orthopaedic Club was held at the Peter Bent Brigham Hospital on February 11. Dr. Harvey Cushing gave a very interesting talk on the

subject of "Hypophysis and Its Relation to the Conditions of Acromegaly, Gigantism, and Pituitary Dwarfism".

Dr. Cushing was followed by Dr. Tracy Putnam, who reported the results of some experiments on dogs that he injected with extract of the posterior lobe. One dog had developed a typical case of acromegaly.

The Eastman Kodak Company has recently opened a school for x-ray technicians in the Medical Division of the Eastman Kodak Company. Courses lasting a week are given free to technicians employed either by accredited physicians and surgeons or by recognized hospitals. This company has experimented widely with x-ray photography and has developed many advanced materials and much technique in the science.

Interpretation of x-ray negatives in medical work requires the basic training and experience of a physician, but most physicians employ technicians to handle the technical side of x-ray work. It is for the more effective training of these specialists that the Eastman Kodak school has been established.

For the school, a section of the Kodak office building has been completely equipped as an x-ray laboratory where the basic photographic principles may be taught. A complete library of medical and physical x-ray literature is available to the students. Lectures will be given by experts from the Eastman Kodak Medical Division and Research Laboratories and from the Medical School of the University of Rochester; there will be practical demonstrations of x-ray dark room work, and an inspection trip through the film manufacturing plant where the technicians will study nature of film.

This new contribution of industry to the medical profession is worthy of note.

In this issue of the *Journal*, **Davis & Geck, Inc.**, announce the first of a series of educational motion pictures, "The Relation of Absorbable Sutures to Wound Healing". This picture gives graphic presentation to the correlation between the reaction of tissue to injury and the factors determining the behavior of catgut under various conditions, as observed in the laboratory and in the clinic. The subject matter embodies the results of extensive research.

The picture opens with the incising of tissue and presents the resultant reactions in the order in which they occur. Microcinematography is employed to show such responses as the acceleration and retardation of the blood stream, the opening of new capillaries in the vicinity of the injury, the formation of the clot with blood platelets oscillating in a network of fibrin, diapedesis, the migration of living leucocytes into the clot, and phagocytosis.

Healing per primum is contrasted with healing by secondary intention, both as to method of attainment and end results. The part played by the suture and the mechanics of the absorption process are clearly illustrated. The important steps in the preparation of absorbable sutures are shown, together with the various tests necessary to insure uniformity of the product.

The latter portion of the picture deals with fundamentals of suture use. Comparisons, in terms of relative strength between the healing rate of tissues and the absorption rate of the various sizes of plain and chromic catgut, provide a basis for accurate selection of the proper suture. Correct and incorrect methods of applying sutures in the approximation of tissue and comparative results are illustrated.

The picture is available for bookings, without charge, to medical schools, hospitals, and accredited professional organizations. Requests for bookings or information should be addressed to Davis & Geck, Inc., Department of Professional Service, 211-221 Duffield Street, Brooklyn, N. Y.

THE CRIPPLED CHILD IN CALIFORNIA

By Rodney F. Atsatt, Santa Barbara, Calif.

The reconstruction and rehabilitation of crippled children in the State of California is now on a rather satisfactory basis. The legislation necessary to make the program complete has recently been enacted in the Crippled Children's Act[1], and through changes in the School Law[2] which pro ide for the schooling of handicapped children.

The Crippled Children's Act may be summarized as follows: Any crippled or physically handicapped child under the age of eighteen, whose parents are unable to pay for proper surgical care, materials, or appliances, is eligible, under the provisions of this act, for care at county expense. The immediate funds for such expenditures are taken from a revolving fund in the State Department of Public Health, which in turn collects reimbursement from the county in which the child resides. Thus the expense of the care of the crippled child is shifted from an unassisted, generous, lay public to be spread over the entire tax-paying community. This is an equitable method of procedure, for in many instances the crippled or handicapped child of to-day is the indigent county charge of to-morrow, and by taking care of the crippled as youngsters, it is often possible to make them self-supporting. Dickie[3], the Secretary of the State Department of Public Health, has recently recommended that a new plan be formulated to take care of the rather large number of patients who have been discovered and the difficulty which some of the counties have had in financing their programs. This new plan would have the county furnish one-third of the cost, the state pay one-third and the interested lay public, service clubs and welfare organizations, contribute the final third. Such a plan seems excellent in that it not only distributes the taxable portion of the cost over a larger number of people, but also gives a chance for local interest and philanthropy.

Under this act the steps necessary to secure aid for a crippled child are as follows:

(1) Contact with the child is usually made through an orthopaedic surgeon or through clinics, surveys or conferences furnished by the State Department of Public Health. The child is examined and an estimate made of the amount of probable improvement and the probable cost of treatment. These estimates in a very simple way are furnished to the interested agency, welfare organization, service club or whoever is sponsoring the child.

(2) Then the parent or guardian, accompanied by a representative of the responsible agency, appears before the superior court of the county in which the child resides and petitions the judge for a certificate to the effect that the parent or guardian is unable, in whole or in part, to furnish the necessary services for the orthopaedic care of the crippled child. The judge satisfies himself as to the financial status of the family, as to the probability of improvement in the child, and as to the approximate cost of treatment; and, if the circumstances warrant it, issues the desired certificate.

(3) This certificate is forwarded to the State Department of Public Health and it then becomes the Department's duty to furnish the necessary orthopaedic and physiotherapeutic services, in whole or in part, transportation to hospital or clinic, hospital care, materials and appliances, as in its judgment are necessary and proper. The first step in fulfilling this duty is to request the examining surgeon to furnish a report on the child, covering diagnosis, physical examination, plan of treatment, prognosis, and approximate cost. The latter is estimated from a schedule prepared by a committee from the various interested orthopaedic clubs and later approved by them. The next step

(1) Political Code, State of California, Section 2979b.
(2) Political Code, State of California, Section 1618.
(3) Dickie, W. M.: The After-Care of Poliomyelitis. Journal Am. Med. Assn., XCI, 1417, 1928.

is the approval of this plan of treatment by the Department of Health and the forwarding of an authorization to the designated surgeon.

As has been stated, the necessary expenses are advanced by the Department out of a revolving fund appropriated for that purpose. All money expended under the authority of the superior court's certificate constitutes a legal charge against the county which issued the certificate and the county must reimburse the state revolving fund.

The plan as outlined above cannot in any sense be confused with state medicine or criticized on that score, for the department itself does not in any way treat the cases, but rather acts as an agent in bringing the patient to the medical profession and underwriting the expenses. While this act has been in force only since May, 1927, the operation thus far has indicated a successful venture in public health activities.

The other aspect of the crippled children's work in this state which makes it most satisfactory, is the cooperative assistance of the school boards which is offered under the new school laws. They make possible the schooling of handicapped children in a most complete way. The school laws may be summarized as follows:

The governing board of any school district shall have the power to provide suitable educational opportunities for the crippled or physically handicapped child. Any minor who can profit by such instruction and who, by reason of a physical impairment, cannot receive the full benefit of ordinary educational facilities shall be considered a physically handicapped individual. (The interpretation of this section can thus be as broad as is desired.)

The governing board of any school district may cooperate with another school district in providing such special instruction. Thus adjoining districts may jointly establish such classes or a district having such classes may contract with another district to educate their physically handicapped children.

The board may also provide for the counseling and guidance of crippled children by the employment of a special teacher-coordinator to study the occupational and future employment possibilities for physically handicapped individuals, and to coordinate the instruction of such pupils with the physical abilities of the child and the commercial and industrial pursuits of the community. It is felt that the creation of such a teacher-coordinator is a progressive step in that there will be worked out a definite plan of education for the crippled child, directed toward having him take a definite place in the commercial or industrial economy of the locality. Upon graduation, every effort will be made by this special counselor to place the individual in the work for which he has been fitted.

The necessary nursing care for handicapped children during school attendance is also provided in the school laws as is the cost of transportation to and from school. In cases where daily transportation is not feasible, the homebound children may be instructed by a well selected visiting teacher. This idea is carried still further by a provision which allows the establishment of classes in preventoriums and sanitariums where a number of physically handicapped individuals may be gathered together. The Division of Special Education offers its services for any principal or superintendent needing assistance in the organization and practice of this type of education.

During the past year a survey has been in progress by the principals and superintendents of the various school systems to locate and record all the physically handicapped children of each community in order that they may be brought under the operation of the new school laws and, where necessary, the Crippled Children's Act.

The problem of the handicapped child in California is apparently being solved satisfactorily by the operation of these two sections of the political code. The experience so far with each law has been favorable and the day will soon come when the crippled child will have a more nearly equal chance with his more fortunate brother.

Notes on a Visit to Orthopaedic Clinics in Europe

Dr. W. P. Blount of Milwaukee, Wis., has recently returned from Europe, after spending six months in visiting medical centers, seeking especially the clinics and hospitals where emphasis is placed on orthopaedic surgery. His observations in regard to the hospitals which he visited on his itinerary were of such interest that a part of his account is given below. It may serve as a valuable guide, just at this time, to many of the readers of the *Journal* who are planning to visit the European clinics and who may by his account be aided in planning to see the type of work in which they are especially interested.—*Editor.*

In the beautiful University of Glasgow, with its Western Infirmary, the surgical chief, Archibald Young, is particularly interested in bone and nerve work. At the Children's Hospital, William Rankin has collected a large series of osteomyelitis cases which are interesting because of his radical diaphyseal resection in the acute stage.

In Edinburgh, D. P. D. Wilkie has a large general surgical service at the Royal Infirmary. Wm. A. Cochrane, his associate, handles the orthopaedic surgery. Considerable fracture work and a good assortment of other bone and joint conditions may be seen. At the same institution, John Fraser has an active surgical service on which there are a large number of operative orthopaedic cases. Sir Harold Stiles has now retired from practice.

In Manchester, Harry Platt has perfected an excellent organization at the Ancoats Hospital. The more pretentious orthopaedic cases are seen in abundance, and a large fracture clinic gives a representative picture of the British method of treatment with splints and early movement. The Delbet plaster splint is used effectively. The Physiotherapy Department, under Miss Royle, is of unusual interest, and rhythmic exercises to music will be new to many visitors.

At Biddulph Grange, about twenty-five miles from Manchester, and at the Ethel Hedley Hospital in Windemere, Mr. Platt has two excellent orthopaedic institutions which would be deserving of a visit for the beauty of the surroundings alone, even if they did not offer excellent opportunities for clinical observation. For each of five hip operations observed, a different incision was used, and in each case the exposure was ideal.

The mention of Liverpool recalls to every visitor the vision of Sir Robert Jones. At historic 11 Nelson Street and at his nursing homes, Sir Robert has a large private practice. The hospital work has mostly been taken over by his devoted pupils, in whom his influence and splendid example are immediately evident. T. P. McMurray has a wealth of material at the Northern, Royal Liverpool Children's and Heswell Hospitals. His sense of humor and his surgery are constant delights to a visitor. Mr. Armour has a general orthopaedic clinic at the Southern Hospital, which is rich in well treated adult cases.

Naughton Dunn at Oswestry had a full schedule. He did his stabilizing operation, which is used in England as the Hoke operation is used in the United States. His work in Birmingham should also be seen.

In Oxford, G. R. Girdlestone has a splendid organization at the Wingfield Hospital. He did his own operation for the production of pseudarthrosis at the hip, and a hip fusion by a modified technique.

London has a wealth of material. A meeting of the London Orthopaedic Society furnished an introduction to many of the men. H. A. T. Fairbank has work at the King's College Hospital and Children's Hospital on Great Ormond Street. In his treatment of fractures, one may observe the good features of the Lane method. His conservative handling of congenital hips is most energetic. If possible, one should visit with him the 400-bed hospital at Alton. Sir Henry Gauvain has had some excellent results from the treatment of surgical tuberculosis with heliotherapy and carbon arc light. He has a fine collection of Finsen appliances. Fairbank does what surgery is necessary.

W. H. Trethowan has his hospital work at Guy's. With his scrupulous no-touch technique, he has operative solutions to many difficult problems. After watching him

do an extensive plastic for slipping patella, one feels that he has witnessed the work of an artist. Mr. Lambrinudi, his assistant, showed interesting operations for pes cavus and drop-foot.

W. Rowley Bristow gives lectures at St. Thomas' Hospital which are well worth frequent attendance. With his assistants, George Perkins and E. P. Brockman, he showed many good cases. The handling of renal rickets, club-foot, torticollis, bone cysts, and derangements of the knee were of especial interest. The more pretentious orthopaedic operations were well represented. At the same hospital, Mennell continues with the extensive use of massage and other physiotherapeutic measures in fracture cases.

R. C. Elmslie and E. Laming Evans operate frequently at the Royal National Orthopaedic Hospital. Elmslie's methods differ somewhat from those of the Jones' school. The reshaping of the first metatarsal head in hallux valgus, the liberal use of tenotomies preceding osteotomy, and the bloodless correction of foot deformities were of interest.

A. S. B. Bankart has a varied orthopaedic clinic at the Middlesex Hospital.

On the way to Germany, one should not fail to stop in Leiden to see Murk Jansen. He is building a new orthopaedic hospital which should be a splendid laboratory for the development of his famous theories. Even in a short visit one can gain some of his ideas on the formation of congenital deformities, dissociation of bone growth, the vulnerability of rapidly growing cells, the cause of tumors, scoliosis, poliomyelitis, and flat-foot. Some practical tricks in the treatment of these conditions may be observed, too.

About fifty miles northwest of Cologne, in the little town of Süchteln, is the 400-bed orthopaedic *Anstalt* of the Rheinland. By changing cars at Krefeld, one may ride three stations on the Personzug to Viersen, which is only twenty minutes by trolley from Süchteln. Dr. L. Roeren, a pupil of Prof. Cramer, has a beautiful group of buildings with modern equipment throughout. Half of the cases are surgical tuberculosis, but in the external immobilization of these, important modifications have been made in the usual braces. Among the other cases, the most unusual procedures are the softening of bones by the Rabel method, the use of a special walking spica in coxa plana, an operation to prevent internal rotation of the hip, and the use of an ingenious chisel in the arthrodesis of knees and perhaps of other joints. A visit to the little known clinic is well worth the trouble it takes to get there.

In Cologne, the 120-bed orthopaedic department of the Bürger Hospital is in charge of Dr. Hackenbroch, Dr. Cramer having retired to private practice. Good results were shown following wedge osteotomies for coxa vara and Schanz osteotomies for neglected dislocated hips. Several years of observation had furnished some interesting conclusions with regard to twenty arthroplasties of the knee.

A severe grippe epidemic had crippled the orthopaedic work in Mannheim, but Stoffel demonstrated his principle in the treatment of flat-foot. The anterior end of the calcaneus and the lateral border of the foot are supported by a special brace. His nerve resection is still used, but in carefully selected cases. Adults and severe contractures are not attempted. Mild cases with localized spastic paralyses offer the best prognosis.

From Heidelberg it is several miles to the new University Orthopaedic Clinic at Schlierbach, but several visits are well worth a little trouble. Prof. von Baeyer has a thoroughly modern 250-bed hospital and is soon to move the Cripple Home to a neighboring building. One should allow ample time for the study of his working models illustrating the mechanics of scoliosis, muscle and joint action, tonus, etc. The practical application of some of these theories is seen in the jointless prostheses, which, like the long leg braces, have flexed knees and plantarflexed feet. X-rays of the lumbar spine with the hips flexed are a decided improvement. The pendulum saw is a useful instrument and is not the only clever piece of apparatus to be seen. An unusual oblique osteotomy of the tarsus has been used in rigid flat-foot with good results. Prof. Vulpius has a private clinic at Bad Rappenau.

At Frankfort a.M., Karl Ludloff is the head of Friedrichshiem, a 140-bed orthopaedic hospital in Niederrad. The oblique osteotomy of the first metatarsal which bears his name is used in cases of hallux valgus and pes cavus. In persistent club-foot the tibialis posterior is transplanted through the interosseus membranes to the cuboid. Semilunar cartilages are removed through a large medial incision, as is usual in Germany. Oberarzt G. Riedel has modified the use of the Schanz screws by fixing them in a perforated plate. The addition of a "mother" bolt-like casing allows the use of the apparatus in a variety of conditions, but it is especially applicable to osteotomies at the upper end of the femur. Victor Schmieden has the surgical division of the Stadtliches Krankenhaus, where bone work is done. In the large department for surgical tuberculosis under Miss (Dr.) Mahler, excellent results are obtained by conservative means. As elsewhere in Europe, the progress of the disease is checked up by frequent precipitation-time determinations. Deep x-ray is used in the treatment, and a visit to the department, under Prof. Holfelder, should be made.

In Magdeburg, August Blencke was remodeling his large private clinic, and no operative work was seen. The softening of bones by encasing an extremity in plaster is a frequent preliminary to a manual osteoclasis. Effective "walking" club-foot plasters were unusual in design. The variety of cases was good. The collection of useful physiotherapy apparatus was a representative one.

Berlin, like London, deserves an extended visit. In the general surgical clinics of Bier, Sauerbruch, and Borchardt considerable bone work is done. One may observe the use of the Kirschner piano-wire extension. In Oskar-Helene-Heim of Dahlem, Biesalski has a large orthopaedic institution. The principle and use of the Quengel method may best be studied where they originated. Oberarzt Friedrich Mommsen has worked out the statics of the body in great detail. The use of the Schulze-Duisberg osteoclast for the bloodless correction of feet and the skeletal traction on the os calcis in club-foot are interesting.

Hermann Gocht has a small but active service at Charité. Oberarzt Kreuz handles most of it, while Gocht operates at Derflingerstrasse 21 on his private cases. There are many unusual departures in technique, especially in the plaster work. Cellucotton, paper, felt, and wood are used a great deal. Wedge osteotomies of the tibia and calcaneus are used in pes calcaneus. The exercises of Hoffa have been modified and are used to advantage in the small gymnasium. Ingenious foot and finger splints may be observed as well as the use of the Stoffel operation, and of *avertin* anaesthesia.

Max Böhm has an active orthopaedic department at St. Hildegard's Hospital in Charlottenburg. Here one may see the application to cases of many of his theories. But most stimulating is the study of the actual models, slides, and anatomical preparations. Böhm is working out the etiology of many of the puzzling congenital deformities and has already published excellent articles on club-foot, scoliosis, knock-knees, and bow-legs. The Alsberg osteoclast is a most useful instrument in his hands. Prof. Wollenberg has done a great deal of work on chronic arthritis. He has a private clinic. Hermann Engel has a clinic at Hindersinstrasse 11, where *Kassa* patients are the rule.

Dresden furnishes a first-hand contact with the original methods of Alfred Schanz which are well described in the new edition of his book. The "luxation arthrodesis" of the foot, the widely used subtrochanteric osteotomy of the femur, periarterial sympathectomy with six per cent. phenol, laminectomy for spina bifida, multiple screw and nail fixation of bones after fracture or osteotomy, a plastic of the opponens of the thumb, and the massive cotton collar are all of extreme interest. Johannes Elsner has a private clinic in which modern methods and excellent plaster work are seen. Bone tuberculosis is treated by an additional rigid diet. A new cripple home is soon to be built. Julius von Finck has a large hospital for tuberculosis.

In the little town of Zwickau i.S., seventy-five miles south of Leipzig, Karl Gaugele heads a well organized 170-bed orthopaedic clinic. He reduces a large number of congenital hips by a conservative technique which has given good results. His theory of the treatment of scoliosis is most interesting.

In Leipzig the clinics of Geheimrat Erwin Payr of the University Hospital and Prof. Schede of the University Orthopaedic Clinic were visited. The latter will soon be in a beautiful new building, but his old one detracts nothing from his work on flat-feet, bow-legs, knock-knees, congenital hips, and rickets. His theory of scoliosis should be contrasted with that of von Baeyer. He has some splendid working models. Payr does a large amount of bone work. He is an advocate of the use of small chisels. An arthroplasty of the knee is an artistic triumph in his hands. *Avertin* anaesthesia is used in some surgical cases. Attendance at his lectures is well worth while.

At Jena, Gulecke's service at the University Hospital is important not only for the excellent bone work done, but also for the modern surgical and x-ray equipment. Piano-wire extension is effectively used in fractures of the os calcis. K. T. Willich, Professor of Orthopaedic Surgery, had a number of unusual cases to demonstrate. Görlach has worked out several new principles in the measurement for and construction of prostheses.

In Nuremberg, Leonhardt Rosenfeld and George Wehner are conducting an interesting clinical experiment to determine the value of conservative treatment in various types of scoliosis.

At Christmas, the season when Munich was visited, surgical activities were almost suspended. At Lange's 250-bed clinic, the application of his principles could be seen, however. Silk tendons are still used. The treatment of congenital hips has been modified and deserves careful study. Osteotomies of the femur have been refined. A specially applied foot plaster utilizes the body weight in the gradual correction of pes equinus and varus. Active exercises with weights and pulleys furnish the bulk of the gymnasium work. The Lange operating table is adaptable to a variety of uses. Hohmann has a large private clinic which should be seen. Lexer has an active 100-bed fracture service in his surgical department of the University Hospital. The application of molded plaster splints and piano-wire extension have been well worked out.

Vienna, the legendary Mecca of medical men, holds only an average attraction for the orthopaedic surgeon. If he can remain for some time, he may be interested in the courses on bone pathology, fractures, general orthopaedics, accident surgery, and cadaver work that are offered by the American Medical Association. Three clinics should be visited in the usual manner. Hans Spitzy has a 200-bed institution where many unusual methods may be seen. The development of the shelf operation; the active treatment of flat-foot, scoliosis, and round back; the early operation of torticollis; closed osteotomy of the femur; and measurement of the active stretching of the spine; all will be of interest to most visitors. A ring clamp for tendons and a grooved awl for starting a bone needle were unusual. Dozent Julias Hass with his assistants, Dr. Fliegel and Dr. Gold, have a good variety at the General Hospital. The treatment of congenital hips has been much simplified, and but one position is used in the average case. In torticollis a subcutaneous myotomy is followed by manual correction and a retentive cast. Arthroplasties are done with a free fat transplant. Primarius Lorence Böhler has an active 100-bed fracture service at the accident hospital. The consistent novelty of his treatment is most stimulating. Local, regional and spinal anaesthesia are employed almost exclusively. Even on the upper extremity, skeletal traction is used to advantage. Greatly modified apparatus is utilized in achieving results which are so good as to warrant a thorough study of the methods. An American will find nothing more "different" in Europe than the Böhler clinic. Carefully applied casts with little or no padding allow early weight-bearing with no untoward results. Zinc lime boots are of great assistance in hastening convalescence. Motion pictures record the important principles in a graphic way.

Graz is conveniently visited on the way to Italy. At the 180-bed accident hospital, Arnold Wittek does considerable surgery in addition to the fracture work. Astragalectomy, according to the Whitman technique, is employed in many foot deformities. Skin flaps and fascia transplants are effective in reconstructive work. Klapp exercises are used extensively in mild spinal curvature. Prof. Erlacher has an original adaptation

of the active treatment of scoliosis. He has a wealth of orthopaedic lore and apparatus at his disposal, and a visit to his children's hospital is most stimulating. His treatment of flat-foot is unusual in its emphasis on the importance of the transverse arch. Skeletal traction on the os calcis and freezing of the tibial nerve are interesting in the treatment of club-foot.

The architecture of Venice is well represented by the beautiful general hospital. F. Delitala has a wealth of orthopaedic material which he can explain in German. His surgical skill was demonstrated by an arthroplasty of the elbow. Fractures of the femoral neck are treated by preliminary traction for ten days and a Whitman cast for fourteen weeks. A useful operating table has been devised by modifying that of Putti. The complete Zander apparatus should be seen.

The Istituto Rizzoli, in Bologna, has well been described as the most perfect orthopaedic institution of the world. One is struck, not by startling novelty, but by sound conservatism. Numerous pretentious operations were seen and good results observed. Extension on the mechanical table is of great assistance during a shelf operation. The observation of a large series of congenital hips has given rise to some interesting discoveries. The after-care of arthroplasties of the knee comprises passive and later active exercises in conjunction with the simultaneous application of heat.

At the Pio Istituto Rachitici, in Milan, Galeazzi has much more to show than his well known treatment of scoliosis. Congenital hips are conservatively reduced by a gentle technique. Skeletal traction is applied with a special apparatus. A modified Stille osteoclast is used in the correction of pes cavus. Lateral scoliosis beds are made with the help of a special frame. The iliocoxometer, arthrogoniometer, and torsion caliper are unusual instruments.

At Rollier's clinic at Leysin one sees excellent results from the conservative treatment of tuberculosis and other diseases of bone. It will be gratifying to some to know that operations are performed, and that knees are even resected in selected cases. A factory for the employment of 120 patients with active and arrested bone lesions is nearing completion.

Anstalt Balgrist in Zurich is too little appreciated. For this orthopaedic work, R. Scherb has 140 beds. Muscle action is studied by actual palpation as the patient walks in a treadmill. The possibilities of this method of investigation have not yet been exhausted by several interesting discoveries. Another rather complicated machine is a marvel of completeness in its range of applicability to the exercise of muscle groups. Schulthess' original apparatus is still in use, although the handling of scoliosis has been somewhat modified. The Albee spine graft is done under local anaesthesia and is frequently employed in tuberculosis of the lumbar vertebrae.

CORRECTION

The following statement is made by Dr. A. Steindler, and Dr. Erich Lindemann, Iowa City, Iowa, and is published at their request: "In our paper on Alteration of the Action Current of Skeletal Muscles Following Sympathetic Ramisection, which appeared in the last issue of the *Journal* (XI, 1, January 1929), the credit for experiments on goats should be given to Dr. Royle instead of to Dr. Hunter as was erroneously stated."

Current Literature

LE DIAGNOSTIC DANS LES AFFECTIONS DE LA COLONNE VERTÉBRALE CHEZ L'ADULTE. By P. Oudard, A. Hesnard, H. Coureaud. Paris, Masson et Cie, 1928, 36 fr.

The authors call attention in the beginning of the book to the change in the situation with reference to the study of vertebral disease,—that now tuberculosis does not comprise the majority of cases seen by either the orthopaedic or the general surgeon. Not only is it recognized that the cases of tuberculosis are fewer in number, but other diseases formerly not understood and practically untreated have now been studied and are receiving successful attention.

In the first portion of the book they give the anatomy, with its important bearing on the localization of lesions, both of bone and nerve, and these observations are accompanied by most excellent figures and plates, particularly the illustration of the nerve distribution as well as the localization of the centers in the spinal cord. The general symptomatology also is very carefully considered from the laboratory point of view.

In the third chapter there is treated the subject of the compression of the cord arising from conditions in the spinal column; with a detailed description of the methods of localization and of diagnosis, and the description of and directions for methods of exploration of the spinal canal; also a special section devoted to the subject of intraspinal tumors.

The second part includes consideration of the subject of various affections of the spinal column,—traumatic conditions, tuberculosis, acute and chronic infectious inflammations, tumor of the spinal column, congenital malformations, and finally the neuroses.

In this book special attention is given to the anatomical features with their relation to the localization and to the treatment of the different lesions, both of bone and of nerve. It is interesting to have the various affections of the spine so treated in a group, with a comparison of diagnosis and treatment, etc., and so placed that the differential points of view in diagnosis and treatment may be had by comparison. It is particularly so in many of these affections of the spine, of which the symptomatology so overlaps that it frequently renders the diagnosis and decision of treatment extremely difficult.

The book will be found a very valuable aid to those who wish to look quite thoroughly into these various affections of the spinal column, and the effect of these lesions on the cord and nerve trunks. The authors have evidently written from the result of a large experience and careful study.

RÖNTGENOLOGY: THE BORDERLANDS OF THE NORMAL AND EARLY PATHOLOGICAL IN THE SKIAGRAM. By Alban Köhler. New York, William Wood and Company, 1928.

This book is a translation by Dr. Arthur Turnbull of the fifth edition, the first time this work has appeared in English. There is a foreword by Mr. John Fraser, Regius Professor of Clinical Surgery, Royal Infirmary, Edinburgh; an introduction to the English edition by Mr. J. M. Woodburn Morison, Royal Infirmary, Edinburgh; and an American preface to the English edition by Dr. James T. Case, Professor of Röntgenology, Northwestern University, Chicago.

The author presents a study of the anatomy and of the development of the body as shown by the x-ray, as a basis for further study and for interpretation of the pathological conditions for clinical purposes. Particularly is it of value to know of the appearance of the skeleton in the early years of life, when the but partial ossification renders the x-ray findings all but fragmentary. The author recognizes also the need of following the appearance of the gradual development of the skeleton to maturity, during that period when the x-ray picture is still incomplete, and it is at this time that this knowledge is most

important. Otherwise, our knowledge is incomplete and many times the peculiarities of development are mistaken for pathological conditions.

The appearances in these early years and the development during the various periods have been carried out in a most thorough and painstaking way, and are illustrated by excellent drawings and x-rays and with clear explanations.

After thoroughly familiarizing himself with this work, and not until he has so familiarized himself, may one feel that he is ready to begin the study of the clinical and pathological x-rays with a sound foundation of knowledge to understand the appearances of the normal.

The main work of the book is preceded by a chapter of very valuable information and suggestions, which is evidently based on a large practical experience and with which everyone should begin the study of x-ray interpretation.

In the same way the author has considered the roentgenology of the soft parts of the body, with the early anatomical conditions and the later developments. The very great variations in the normal which are found in examination of the gastro-intestinal tract and the appendages are gone into in detail and are fully illustrated.

The author states that he has purposely omitted some of the new methods of examination, many of which have not yet proven their accuracy or their need, yet retained some of the earlier illustrations used in the former editions. These are not of the same excellence as would be expected in the later period and which are obtained at present, but the author has used them to serve as an illustration of the change and the progress which has been made in roentgenology.

The reader is to be congratulated on the excellent translation which Dr. Arthur Turnbull has given, for the text is in particularly clear English and yet the original has not lost accuracy in the change of language.

CHEMISTRY IN MEDICINE. A COOPERATIVE TREATISE. Edited by Julius Stieglitz, Ph.D., Professor of Chemistry, University of Chicago. New York, The Chemical Foundation Inc., 1928.

A cooperative treatise intended to give examples of progress made in medicine with the aid of chemistry. "This book is dedicated to the welfare of your children and your children's children by its authors and publishers."

It is a beautifully printed book of over seven hundred pages, arranged in nine comprehensive chapters, many of which chapters are divided into sections, each section written by the best authority of the country on the subject; thus the subject matter is reliable and brought up to date. Some of the sections dealing with chemical subjects are illustrated by chemical formulae which are difficult for anyone but a trained chemist to understand; and as the matter is written by different authors it has perhaps not the brilliance of style and continuity which is desirable. What the "Microbe Hunters" and "Hunger Fighters," books of similar nature of Paul De Kruif, are to the laity, this book should be to the professional man. Although this book is undoubtedly made harder to read because the subject matter has been boiled down and condensed, yet it is a book which every doctor and scientific man could read with interest and profit, and have on his shelf for reference.

CONSTITUTIONAL PATHOLOGY IN ORTHOPAEDIC SURGERY; HEREDITARY BIOLOGY OF THE PERIPHERAL LOCOMOTOR SYSTEM. By B. Aschner and G. Engelmann. Vienna and Berlin. Julius Springer, 1928.

In presenting this important and interesting paper the authors satisfy a much needed demand for enlightenment and information on the most obscure aspects of orthopaedic practice. The introduction of the book is devoted to the theoretical consideration of the laws of heredity. The Mendelian law is thoroughly discussed in its principles and variations.

An interesting topic is opened with the discussion of the so called exogenous factors as causes of deformity, and it is shown that many of these are really produced upon a background of hereditary agencies.

Numerical variations of skeletal systems are represented in the chapters on Polydactylia, Syndactylia, and Ectrodactylia. The defects of long pipe bones, absence of patella, etc., are given ample space in which the importance of hereditary biological factors in these conditions is pointed out.

The chapter on Enchondral Disturbances of Bone Growth includes sections on brachydactylia, hyperphalangism, symphalangism. For each of these groups substantial proof of their hereditary background is adduced. Systemic bone disturbances are represented by chondrodystrophies and multiple cartilaginous exostoses.

Of the acquired disturbances of epiphyseal growth, Madelung's deformity and osteochondritis deformans of the hip, Perthes' disease, as well as Köhler's disease, Osgood-Schlatter's disease, are considered from the viewpoint of intrinsic hereditary influences. Likewise, periosteal and endosteal growth disturbances, such as osteogenesis imperfecta and the marble bone disease of Albers-Schönberg, are viewed from the same angle. Of the growth disturbances of the membranous preformed bone, dysostosis cleidocranialis is particularly interesting because of its strong and dominant hereditary background.

Among the more uncommon transmissible skeletal anomalies are mentioned the periosteal hyperplasia of the skull, the oxycephalous and similar congenital aberrations. There is also discussed the genetic factor in partial gigantism and in such skeletal anomalies as arachnodactylia.

Probably the most important chapter from the practical point of view is the one dealing with the Deformities of the Spine. In the description of these, of congenital aberrations, the features of familial influence are especially stressed. Of equal importance, though less firmly established, is the hereditary genesis of congenital and habitual dislocations, among which, naturally, the congenital dislocations of the hip are the most extensively discussed. There is also given a very extensive literature table on concomitant deformities in congenital hip dislocations.

An interesting chapter is devoted to the hereditary influences on congenital clubfoot and club-hand. Lesser deformities of this group, such as congenital radial ulnar synostosis and the congenital dislocations of the radius, are given appropriate space; nor are the synostosis of the cervical vertebrae, the so called Klippel-Fiel syndrome, and some of the more uncommon systemic diseases of the skeleton—for instance, the hypertrophic osteo-arthropathy of Pierre-Marie—omitted.

The authors further dwell upon interesting points regarding the heredity of myositis ossificans.

The last chapter is devoted to heredity in infections, especially of osteomyelitis, lues, and tuberculosis.

In the presentation of this great subject, the authors distinguish two principal hereditary factors affecting the normal or pathological peripheral locomotor apparatus. One factor determines the location by producing lesser resistance or a biological inferiority of the respective parts; the other factor determines the type and kind of the hereditary anomalies. This system is consistently carried through the many conditions which are considered in this work.

The book is written with astounding thoroughness and completeness. A voluminous literature is cited. In all its aspects the work appears as a thoroughly scientific and interesting presentation of the subject and ought to be of great value, not only for the practicing orthopaedic surgeon, but for the anatomist and pathologist as well.

The *Journal* wishes to acknowledge the receipt of the following books sent to the Editorial Department:

Chirurgie de l'Articulation Temporo-maxillaire. By Dr. L. Dufourmentel. Paris, Masson et Cie, 1929.*

GIORNALE MEDICO DELL'OSPEDALE CIVILE DI VENEZIA. Venezia, Vol. II, No. 6, December 1928.

BULLETTINO E ATTI DELLA REALE ACCADEMIA MEDICA DI ROMA. Rome, Vol. LV, Nos. 1 and 2, January and February 1929.

EL CONGRESO HOLANDÉS DE PROTECCIÓN DE INVÁLIDOS. By Doctores Oller y J. Montero. Madrid, 1928.

SOBRE UN CASO DE NEURITIS TRAUMÁTICA (accidente del trabajo). By Doctor JOSÉ MARÍA MARTÍNEZ. Madrid, 1928.

DIFFERENTIALDIAGNOSTIK DER INNEREN KRANKHEITEN DES BEWEGUNGSAPPARATES. By Priv.-Doz. Dr. Ernst Freund and Dr. Albert Simo. Dresden-Blasewitz, Theodor Steinkopff, 1928.*

*To be reviewed in a later issue of the *Journal*.

THIRTEEN CASES OF IMPACTED MEDIAL FRACTURES OF THE NECK OF THE FEMUR. G. Odelberg-Johnson (St. Erik's Hospital). *Acta Chir. Scandinavica*, LXIII, 107, 1928.

The author collected thirteen cases of medial impacted fractures of the femoral neck in women between fifty and eighty-five with osteoporosis. In all cases a wide contact between the fragments was verified from the start by roentgen-ray examination taken in two planes at right angles. Practically all were merely treated with rest in bed for two to three months, and fixation of the limb with sand bags (position not mentioned); no reduction. Massage and movement were initiated as soon as the patient could lift the limb straight from the bed. In spite of early weight-bearing, which the author advises against, eleven cases obtained bony union. Roentgenograms showed maximum decalcification reaching its maximum at two to three months. Only after ten to eleven months did calcification commence, generally as a mottled sclerosis in the fractured ends. Only after about two years is the whole cancellous system of the femoral end reestablished.

These cases tend to confirm the old assumption that a large percentage of impacted medial fractures of the femoral neck unite under formation of callus. In none of the cases did shortening exceed two centimeters. The author believes with Kocher that medial fractures of the femoral neck arising from a blow on the lateral aspect of the great trochanter are a combined compression and bending fracture.—*J. E. Milgram, M.D., Iowa City, Iowa.*

ON THE FORMATION AND DISAPPEARANCE OF AMYLOID IN MAN. Henning Waldenström. *Acta Chir. Scandinavica*, LXIII, 479, 1928.

Amyloid in man is considered to be a substance which, when once deposited, does not again disappear. The author submits pathological material of three cases as evidence of the fact that amyloid can disappear from the liver, and the patients recover.

Amyloid is a protein, rich in tyrosin, soluble practically only in pepsin or trypsin, and deposited along blood vessels, between them and the tissue cells. It occurs particularly during prolonged suppurations.

Josephson in 1916 punctured the spleen and thus obtained tissue for study.

In 1917 Waldenström commenced to utilize this procedure. Under local anaesthesia, a one and one-half millimeter needle is inserted through the skin and then pushed into the liver. When the respiratory movements are reflected in the movements of the needle, it is inserted another two centimeters. The trocar is removed, and the needle pushed another centimeter into the tissue. A syringe is attached and suction produced by quickly withdrawing the piston, when a piece of detached liver may jump into the syringe. No discomfort resulted.

He has examined twenty-five cases. All have been tuberculous. All but two had sinuses. Of the two, one had a chronic septic pleural empyema while the other, a spondylitis with a large caseating bronchial gland, apparently was a case of pure tuber-

culosis, without secondary infection. In three of his twenty-five patients who proceeded to get well after surgical drainage and heliotherapy, amyloid obtained in large quantities at the onset was seen on repeated punctures to progressively diminish in quantity until it had entirely vanished.

Autopsy findings show that amyloid when present is evenly distributed throughout the entire liver so that his biopsy represents the condition in the entire liver at the time of puncture.

Only by puncture can a reliable diagnosis of amyloidosis be made in a debilitated patient with an enlarged liver and spleen and albumen in the urine.

The author maintains that by treating the cause of the amyloid,—*i.e.*, the suppuration—the amyloid can be made to disappear. One of his recovered cases had abdominal ascites and a liver which extended to the iliac fossa.

He has observed that for amyloid to be deposited, suppuration must be copious, long in duration (at least one to two years in the author's cases), and must greatly impair the general condition of the patient. A liver of normal size may contain amyloid in great quantity. The kidneys may be full of amyloid and yet show no albumen in the urine.

There is appended to the article detailed case reports and interesting photomicrographs.—*J. E. Milgram, M.D., Iowa City, Iowa.*

A Case of Osteitis Fibrosa with Multiple Fibromyxomatous Muscle Tumors. Ali Krogins (Helsingfors). *Acta Chir. Scandinavica*, LXIV, 465, 1928.

The author describes his case of osteitis fibrosa cystica generalisata in a thirty-eight-year-old female. In the course of five years several tumors arose in the patient's muscles. This patient had fractured her right tibia six times between the ages of six and fifteen and presented osteoid and cystic changes in tibiae, fibulae, femora, and the humerus. A large goiter was present in adolescence. In her second and third decades she was repeatedly operated on for removal of soft-part growths. Histologically these appeared as fairly well defined fibromyxomata.

A similar case in a sixty-six-year-old female was reported by Henschen in 1924. No other reported case is know.

The author believes there exists a genetic relation between the bone and muscle tumors and that both represent a process of fibrous degeneration of analogous character.

In view of the recent work on the pathogenesis of the group of obscure bone dystrophies, the article is of considerable interest. —*J. E. Milgram, M.D., Iowa City, Iowa.*

A Case of Chisel-Fracture (Meisselfraktur) of the Head of the Radius Which Became Visible only after the Lapse of Time. Sven Junghagen. *Acta Chir. Scandinavica*, LXIII, 475, 1928.

The author reports two cases of this type, in one of which five months and in the other four weeks elapsed before the fracture became visible in repeated x-rays. These fractures occur in the sagittal plane through the middle of the head paralleling the longitudinal trabeculae and extend through the lateral cortex. They may be easily overlooked as trabecular markings, especially if the line of cortical fracture is not definite. Only after displacement of the lateral fragment downward and laterally is fracture diagnosed. The prevention of secondary traumatic arthritis of the elbow lies in early recognition and prevention of displacement by sufficient immobilization.—*J. E. Milgram, M.D., Iowa City, Iowa.*

The Hereditary Type of Angioneurotic Oedema. Harold F. Dunlap and Willis S. Lemon. *Am. J. Med. Sciences*, CLXXVII, 259, Feb. 1929.

Angioneurotic oedema, known as Quincke's disease, is characterized by an acute massive ephemeral swelling of the skin, of various mucous membranes, or of the viscera,

a swelling which recedes without leaving a residue. The condition is chronic, with a tendency to recurrence. An attack may last a few hours to one or two days.

The etiology is unknown, but in the literature it is regarded as a type of urticaria, and thermal changes seem to act as precipitating cause. Heredity plays a distinct part.

Symptomatically, there are four clinical groups. 1. Subcutaneous tissue alone is involved. 2. Mucosa of the respiratory systems are primarily involved. 3. A combined form of oedema begins in the face and spreads to the mucosa of the pharynx and larynx. 4. Intestinal colic exists without external signs of oedema. One and four seem to constitute the most common types and are the least dangerous. The author reviews the literature and reports a familial case and three cases in which there was no hereditary factor.—*J. A. Key, M.D., St. Louis, Mo.*

Ipsolateral Oedema and Contralateral Jaundice Associated with Hemiplegia and Cardiac Decompensation. Irvine H. Page. *Am. J. Med. Sciences*, CLXXVII, 273, Feb. 1929.

Two cases of ipsolateral oedema and contralateral jaundice on the basis of cardiac decompensation following hemiplegia are presented and the relation of this phenomenon to cellular permeability discussed.

The author says that at present there is no proof of the direct control of permeability by the nervous system, but there are experiments and examples which suggest this. For example: if the right cervical sympathetic system is removed from an animal and fluorescein injected into the peritoneum, the dye later will be seen in the right vitreous, but none in the vitreous of the left eye. In one case quoted he shows that hemiplegia produces vasomotor paralysis or instability. Active transudation of fluid and arterial hyperaemia result from vasomotor paralysis, but up to the present there are not sufficient data to prove that there is a change in the osmotic pressure of the blood in these cases of regional oedema. The causative, or one of the causative, agent of local anoxaemia is given as deficient oxygenization of the blood in the lungs and increased oxygen consumption resulting from the stagnation of the blood in the capillaries.

An adequate explanation of the lack of penetration of bile pigments into oedematous cells is, as yet, impossible, as there are too many factors that need explanation.—*J. A. Key, M.D., St. Louis, Mo.*

Variations of the Bones of the Foot. James B. Bullitt. *Am. J. Roentgenol.*, XX, 548, Dec. 1928.

Case is reported of a man, age thirty-five, who sprained his right ankle. X-ray examination showed no bone injury, but did show fusion of talus and navicular. X-ray examination of the left foot showed the condition to be the same.

Skiagraphs of these anomalies are shown. The author states that there is nothing in the history of the case to suggest the possibility of a pathological process, but feels that the condition is congenital beyond question.—*Edward S. Hatch, M.D., New Orleans, La.*

Fracture of the Radial Cubicle. Mlle. Denise Ronget. *Ann. d'Anat. pathol.*, V, No. 7, July 1928.

This author presents three cases of isolated fracture of the radial cubicle and points out that these fractures, which are very rare, can be put into five groups: (1) comminuted fracture of the head with a penetration of the neck; (2) fracture with displacement of the fragment; (3) fracture without displacement; (4) a simple crack in the radial head; (5) a simple notch in the cubicle.

In the case of fracture with displacement of the fragment, the only efficient treatment is surgical, with extirpation of the fragment. This operation always should be performed early in order to obtain the best results. The operation is easy. The only danger is injury to the lower branch of the radial nerve, which it is necessary to avoid at the point where it winds about the neck.

In other varieties of fracture, the treatment consists of immobilization for several days, with massage and early mobilization.—*Jacques Calvé, M.D., Berck-Plage, France.*

AINHUM. Jacob G. Probstein. *Ann. Surg.*, LXXXVIII, 885, Nov. 1928.

The author gives a short review of the literature concerning the disease called Ainhum or "Dactylosis Spontanae", plus the presentation of a case. This disease is characterized by a slow amputation of one or more digits, generally a symmetrical separation of the little toes, although other toes or even fingers may be affected. It is of unknown etiology occurring usually in adolescent male negroes. A fissure forms at the base of the toe or toes which deepens and spreads until the digit is dropped. The course is slow, lasting from two to twenty-five years, being without pain at first but may become very painful later. Beyond the ring of constriction the toe becomes enlarged and bulbous. There are no constitutional symptoms. Treatment is early amputation.—*L. Miltner, M.D., Iowa City, Iowa.*

MYELOMA OF THE SPINE. Donald C. Durman. *Ann. Surg.*, LXXXVIII, 975, Dec. 1928.

One case reported in detail with autopsy findings. The x-ray findings are regarded as characteristic. There is extensive rarefaction of the bone with flattening of the bodies of the vertebrae but not much narrowing of the intervertebral cartilages.

CONCLUSIONS:

(1) Myeloma of the spine is a rare disease, but one that should be kept in mind when examining for spinal pathology.

(2) The clinical course and findings are rather definite. The apparent indefiniteness of the clinical signs is in itself typical.

(3) The absence of Bence-Jones bodies from the urine does not preclude the possibility of the disease. The presence of these bodies should serve as confirmatory rather than indicative evidence.

(4) There is often a disturbance in the blood picture. The blood should be carefully studied in all suspected cases.

(5) The roentgenological findings are diagnostic.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

HISTOLOGICAL EXAMINATION OF SYPHILITIC TIBIAE. F. Nestmann. *Arch. f. Orthop. u. Unfall-Chir.*, XXVI, 237, Mar. 1928.

According to generally accepted opinion the bone suffers a panosteitis,—*i.e.*, a periosteitis and osteitis with specific granulation tissue, the latter being replaced later by newly formed bone. This new bone is formed in abundance partly from periosteum, partly from the bone marrow. In the majority of cases the remnants of the old cortex are not sharply defined, but there is a gradual transition from periosteally formed new bone to the porous corticalis and spongious bone. Owing to extensive osteitic destruction of the cortex, especially where periosteal lamellation is less evident (in younger individuals) differentiation against osteodystrophia fibrosa often becomes important. Against the latter, the involvement of the periosteum and the narrowing of the marrow cavity is of significance. Also the mosaic structure in lues differs from that in osteodystrophy, in that it is localized, and not as coarsely marked as the latter. Osteodystrophia fibrosa is a dystrophy, not an osteitis; there the disturbances of bone metabolism is the basis. The bony structure is uniformly and diffusely changed. Lues is an inflammatory destructive process, in which bone is destroyed, replaced by scar tissue and only later a transformation of this scar tissue occurs from the marrow cavity toward the cortex. Findings on luetic tibiae show that even on the macerated specimen the distinction between lues and osteodystrophia fibrosa (Recklinghausen) can be made and is the basis of diffuse mosaic structure in the latter and the occasional and circumscribed, inflammatory destruction of the former.—*A. Steindler, M.D., Iowa City, Iowa.*

TREATMENT OF PSEUDARTHROSIS (AFTER KIRSCHNER). Lindemann. *Arch. f. Orthop. u. Unfall-Chir.*, XXVI, 287, Mar. 1928.

In 1923 Kirschner recommended a new procedure for the treatment of bony deformities. Without stripping the periosteum he splintered the bone in longitudinal

direction until a certain degree of plasticity was obtained and the bone could be straightened out. Consolidation occurred promptly. Kirschner advocated this method also for the treatment of pseudarthrosis. The splintering process opens the marrow cavities and the mechanical irritation of the procedure stimulates callus formation. The author reports four cases, in which on the other side, for sake of comparison, simple osteotomies were carried out. The cases showed that consolidation occurred after four to five weeks on both sides. The cosmetic effect was the same on both sides. All cases were rachitic deformities of the tibiae.—*A. Steindler, M.D., Iowa City, Iowa.*

Diseases of Intervertebral Discs. E. Lyon. *Arch. f. Orthop. u. Unfall-Chir.*, XXVI, 295, Mar. 1928.

Of particular interest are the newer investigations on pathology of intervertebral discs, which, according to Schmorl, are much more frequently involved than is generally known. Degeneration and trauma play the leading part in the pathogenesis.

Premature signs of senescence of the spine include an increasing defibrillation and disintegration of the disc, a sort of drying out, which proceeds to a point of calcification of the intracellulary substance of the disc. These changes carry with them similar changes of the bony structures and of the ligamentous apparatus of the spine, since the latter, especially after the buffer action of the disc has been lost, becomes subject to abnormal strains and concussion and responds to it by calcification (arthritis deformans).

Rupture of the disc is not uncommon. It is followed by diffuse degeneration. This occurs, for instance, in spondylitis deformans, in which the spurs and bridges appear as secondary formations.

The spondylitis in tabes dorsalis is likewise primarily a trauma of the disc followed by trophic changes. Near the damaged disc periosteal thickenings are found and repeated traumatism, facilitated by the insensibility of the structures, leads to excessive and monstrous bone hypertrophies. Spondylitis deformans tabetica is probably much more frequent than is generally assumed.

As far as the severe injuries of the spine are concerned, Hoffmann found in his weight experiments on isolated spines that when the posterior longitudinal ligament was ruptured there was always a rupture of the lowermost disc.

Of particular interest is the behavior of the disc in infectious diseases. The investigations of Schmorl have shed much light upon this subject. Especially in typhoid pathological changes of the disc are seen flattening, later disappearance, and complete fusion of the adjacent vertebrae. According to Schmorl the typhoid spondylitis starts from the edges of the vertebral portions adjacent to the discs. The infection takes its start from an infarct of an intra-ossal vessel. A process of molecular necrosis and softening follows. The discs, by their intrinsic pressure, protrude into the vertebral substance causing an indentation of the latter. Then the discs become vascularized from the spongious substance of the bodies and the bacilli now are able to penetrate into the disc. Inflammatory and degenerative processes now produce the narrowing of the disc which ends with its complete disappearance. So the involvement of the disc is really secondary; a primary involvement is, in spite of roentgenological evidence, not likely. There is no doubt that an old typhoid spondylitis predisposes to spondylitis deformans.

Other infectious diseases produce similar pictures. A spondylitis gripposa with secondary involvement of the discs is described by Baron.

According to Sgalitzer and Schmorl, there is also a tuberculosis of the intervertebral disc, always preceded by a vascularization of the latter. Schmorl also found a gumma in a vascularized disc. In osteoporosis, Schmorl found that the deformities of the spine assume the highest degrees where the discs remain intact ((atrophic arthritis of spine). Where the disc degenerates a spondylarthritis deformans develops, with formation of marginal spurs and bridges, which present gross deformities of the spine.—*A. Steindler, M.D., Iowa City, Iowa.*

OPERATIVE AND CONSERVATIVE TREATMENT OF CEREBRAL DIPLEGIAS AND HEMIPLEGIAS. Erich Brinkmann. *Arch. f. Orthop. u. Unfall-Chir.*, XXVI, 621, Oct. 1928.

Reports of ten cases—there was no picking of favorable cases. In all instances the Stoffel operation succeeded in relieving spasticity to the point of active functional use. Patients were then submitted to active educational methods. A resistance was created by means of weight and the patient forced to active muscle work by means of resistant movements. Stress is laid upon the patient spending the time between treatments and exercises in bed. Massage and electricity were omitted in most cases because of the fact that they increased the psychic irritability of the patients.

A great point is made in establishing the intelligence factor. The author distinguishes three groups: one with normal intelligence, one with marked mental deficiency, and an intermediate group. In this latter group there is no evident intelligence defect, but the children are unable to concentrate except for a few minutes at a time. In the reeducation of the gait the author proceeds very slowly and systematically, keeping always in mind that the pathological gait caused by the spasticity has become a deep-seated habit which requires a great deal of time and patience for correction.

As to recurrences after Stoffel's operation, the author believes that, if the operation is carried out properly,—*i.e.*, if at least two centimeters of the motor nerve are resected and the stumps are either tied or implanted into another nerve, a recurrence will very rarely appear.

The exercise therapy is based upon substitution,—*i.e.*, the non-affected parts take over the function of the affected ones. Therefore, the question is whether or not there are sufficient substitutionary paths available. In the nature of the pathology of chorea and athetosis, little can be expected in these conditions of operative measures. Here, all that can be done is to utilize the natural route of substitution or compensation by educational methods.

The interrelation between the pyramidal and extrapyramidal systems offers the possibility of equalizing the extrapyramidal disturbances by efforts of the pyramidal tracts (practice and effort of will).

In all cases operated by the Stoffel method, combined with tendon operations, the author succeeded in restoring active mobility of the extremities. By following it up with extensive medico-mechanical exercise therapy, very good functional usefulness of the extremities was obtained.

Tendon and muscle transplantation were never necessary. There were no recurrences. Imbecility or low intelligence is a great handicap. Disturbances of the extrapyramidal system (chorea, athetosis, etc.) can be influenced favorably by exercise therapy, but only in the mildest cases can they be totally eliminated.—*A. Steindler, M.D., Iowa City, Iowa.*

CONTRIBUTION TO THE KNOWLEDGE OF INJURIES TO THE SEMILUNAR BONE. Pförringer. *Arch. f. Orthop. u. Unfall-Chir.*, XXVI, 641, Oct. 1928.

Kienbock considered the condition as one of traumatic osteomalacia. Based on his experience of sixteen cases he comes to the conclusion their pathological basis is a disturbance of the nutrition of the bone, caused by contusion or distortion of the wrist with rupture of ligaments and blood vessels. The author distinguishes several types. In one there is the picture of Kienbock's osteomalacia; he reports four cases of this group. In the second group (three cases) there were injuries to the scaphoid as also of the semilunar. The fracture of the semilunar had healed without leaving structural changes. In the third group (three cases) there are found cavities in the semilunar; one case was associated with fracture of the radius.

In his cases, the author could demonstrate only once the beginning and the final stages. In this case there was no doubt that the malacia was the result of a primary fracture. This is in accord with the investigations of Schmorl on the effect of trauma upon atrophy of the vertebrae. He found that often insignificant traumata may produce a

severe disintegration of the vertebra and that fracture often occurs which escapes the attention of patient as well as surgeon.

The microscopic examination of the semilunar after removal shows more or less extensive necroses. They are of the type of the aseptic necrosis of Axhausen, who upon the strength of this finding rejects the traumatic pathogenesis in favor of the embolic theory. Lately Axhausen has found fresh bone infracts in the femur (osteochrondritis deformans) so that one may by analogy, apply this fact to Kienbock's disease, although direct findings of embolism in this bone are not at hand. On the other hand, the cavities found in the semilunar, are, according to Hirsch, the results of fracture. The author inclines toward the traumatic theory of pathogenesis and considers the condition as one of old semilunar fracture.—*A. Steindler, M.D., Iowa City, Iowa.*

CONCERNING THE INVESTIGATIONS ON THE HEREDITY OF ORTHOPAEDIC CONDITIONS. E. Isigkeit. *Arch. f. Orthop. u. Unfall-Chir.*, XXVI, 659, Oct. 1928.

Concerning the congenital dislocation of the hip, the author could prove on the basis of a numerous material that the heredity coefficient is rather high,—*i.e.*, twenty per cent. If one further considers that most people have only very scant information about their ancestry and relatives, and that in the recession polyhybrid types of heredity a deformity may remain latent for several generations, one should be inclined to set the heredity factor rather high.

The congenital dislocation is the most frequent of all congenital deformities and occurs at a rate of about two per cent. of population; the number of people carrying a latent hereditary factor must, therefore, amount to a considerable percentage of the population. We must assume that there are now sexual and dominant sexual factors at work. An accurate hereditary formula cannot be given.

The great number of breech and cross presentations as well as the frequent scarcity of amnion fluid points to mechanical-traumatic factors. Whether these are sufficient explanation is doubtful. Experiments have shown that it is next to impossible to produce a dislocation of the hip in the new born. As far as the pressure of the uterine wall is concerned (smallness of uterus), it may exceptionally be the cause of congenital dislocation, especially in cases associated with other congenital deformities. But the certainty does not apply to the large majority of congenital hip dislocations. There is also no explanation for greater incidence of the congenital hip dislocation on the left side.—*A. Steindler, M.D., Iowa City, Iowa.*

CONSTRUCTION TYPES AND BLOOD SUPPLY OF THE FOOT IN CONNECTION WITH THE MECHANICS OF THE FLAT-FOOT. J. B. Rywlin. *Arch. f. Orthop. u. Unfall-Chir.*, XXVI, 740, Oct. 1928.

There are three types of foot: the arcuar, the flat, and the intermediate type. From the viewpoint of evolution the arcuar type is the progressive one, the flat type the atavistic one.

The form of the foot is determined by the external fornix ($\frac{h}{s}$) the greater index characterizes the arcuar and the smaller the flat type. The former view on the so called pes planus spurius in children based on clinical observations (sole impressions) is borne out by anatomical investigations; the index of the outer fornix (arch) may be high, low, or intermediate in children. Characteristic for the arcuar fornix is the more powerful development of the trabeculae in comparison with the inner fornix; then the flat-foot conditions are reversed. This latter fact points to the independent function of inner and outer arch. Among the numerous anomalies of arterial supply of the foot, the author also distinguishes three types: the progressive, peculiar to the arcuar type of foot,—the development of the dorsal system is prevalent; the atavistic type is characterized by prevalence of the plantar system of arterial supply; the intermediate type between the former two.

The meager development of the plantar system in the arcuar type of foot must, among the conditions predisposing to flat-foot, create a propensity to develop a pes

planus dolorosus. These peculiarities in the blood supply of the arcuar foot may also produce vasomotor disturbances as the primary factor, which secondarily leads to static disturbances.

On the other hand, the predominance of the plantar system in the flat type makes this type very resistant against circulatory impairment. It follows that in the flat type static influences are the primary factors in the development of flat-foot. This applies especially to the severe flat feet which develop without vasomoter symptoms.—*A. Steindler, M.D., Iowa City, Iowa.*

THE DEVELOPMENT OF BONE. J. C. Watt. *Arch. Surg.*, XVII, 1017, Dec. 1928.

The process of development of bone is studied in: (1) intramembranous bone, where there is noted a calcification of the fibrous matrix, associated with a deposit of fine granular bone around the osteoblasts; and (2) endochondral bone in which there is (*a*) a rearrangement of the cartilage cells to form trabeculae; (*b*) a degenerative process of these cells followed by calcification; and (*c*) invasion of the cartilaginous bone by blood-borne osteoblasts which replace the calcified mass by ossified periosteoblastic deposits. Histological differences are noted in the calcification that occurs in cartilage where the granules are relatively large and do not fuse with each other, and the ossification produced by osteoblasts where the granules are very small and fuse to form a solid mass. Evidence is summarized to indicate that the deposition of bone is the direct result of cellular activity. Excellent microphotographs help to visualize some of the processes described.—*I. Wm. Nachlas, M.D., Baltimore, Md.*

THE VIABILITY OF TRANSPLANTED BONE. W. E. Pollock, P. W. McKenney, and F. E. Blaisdell. *Arch. Surg.*, XVIII, 607, Feb. 1929.

In an effort to determine the viability of transplanted bone in normal tissue fluids without the assistance of vascularization from adjoining tissues, the authors imbedded live rib grafts in membranes made from the inner surfaces of the middle layers of an onion and also in collodion capsules that had been found to be favorable for dialysis, and transplanted them as well as control live and dead (boiled) grafts in the muscles of the back, in the abdomen, and in the knee joint. In the collodion and in all but two of the onion membranes, the inroads made by vascularized fibrous tissue indicated a failure of the isolating wrappings. The two successfully isolated live grafts died. New bone formation was noted in some of the live grafts which had become surrounded by vascularized fibrous tissue. Around the boiled grafts there was no evidence of new bone formation.—*I. Wm. Nachlas, M. D., Baltimore, Md.*

SUBASTRAGALAR ARTHRODESIS. W. Russell MacAusland. *Arch. Surg.*, XVIII, 624, Feb. 1929.

Offered as a simplified procedure for the stabilization of paralytic feet and the surgical fixation for fracture or disease about the subastragular joint, the MacAusland operation is said to be of use in patients over twelve years of age. It is described as superior to the Davis and Hoke operations in its simplicity and particularly in the posterior displacement of the foot that it permits. The operation consists of the exposure of the inferior aspect of the astragalus by severance of the astragaloscaphoid and calcaneo-astragalar ligaments and forcible inversion of the foot. The lower third of the astragalus is removed by transverse section. A corresponding section of bone is removed from the top of the tarsal region back to the tip of the scaphoid. The foot can then be displaced backward. By making the removed bone thicker on one side or another, the valgus or varus deformity, as the case may be, can be corrected. Additional wedges may be used for the correction of a cavus deformity. A report of eight cases and diagrams, roentgenograms and photographs are included in the article.—*I. Wm. Nachlas, M. D., Baltimore, Md.*

ALLERGY AS A FACTOR IN THE PRODUCTION OF PROLIFERATIVE ARTHRITIS. J. A. Freiberg. *Arch. Surg.*, XVIII, 645, Feb. 1929.

Using an extract of B. dysenteriae Flexner for intra-articular injection, the author produced a monarticular arthritis in rabbits. The arthritis produced simulated the proliferative type of arthritis in man. Subcutaneous injections of bacterial extract did not produce any joint lesion.

It is the opinion of the author that the experimental arthritis is the response of a generalized allergic state to a bacterial extract. The experiments indicated to Freiberg that the proliferative arthritis in man is likewise a local allergic manifestation and he suggests that the gastro-intestinal tract may be the site of such infections.

Ample experimental material, numerous checks and controls, and instructive collateral experimentation add to the value of these observations. Microphotographs, macrophotographs, and tables of protocols help in their presentation.—*I. Wm. Nachlas, M.D., Baltimore, Md.*

AN OPERATION FOR MAKING THE FOREARM PREHENSILE AFTER LOSS OF A HAND. A. K. Henry. *British J. Surg.*, XVI, 188, Oct. 1928.

The author's plan was:

(1) to cut from the outer side of the radius a rod of bone which should have about the total length of a normal thumb;

(2) to leave in situ the thumb tendons already related to this piece of bone;

(3) to make two false points in the rod;

(4) to attach two flexor tendons to the jointed rod;

(5) to enclose the structures in a tube of skin;

(6) to set the new digit obliquely across the palmar surface of the stump so as to appose its ulnar border.

The end result resembles a prize-fighter's glove.

While the technical difficulties proved too great, the patient had a useful stump in that the movement of pronation imparted a grip to the stiff digit fixed at an angle to the radius.—*R. Breitman, M.D., Iowa City, Iowa.*

AN UNDESCRIBED DISEASE OF BONE. J. H. Sheldon. *British J. Surg.*, XVI, 405, Jan. 1929.

A boy of eleven developed a bony tumor on the head of the right tibia. At operation this proved to be an osteoma, but multiple fibromata were noted in the patellar tendon. Six years later a second operation was done for recurrence, but the tumor was found to be in the patellar ligament and the capsule of the knee joint with another area in the rectus muscle. The left knee showed a beginning growth with a line of ossification in the patellar ligament. After the second operation the disease developed faster. Soft painless swellings appeared in the wrist, elbow, arm, and axilla; ruptured; and discharged sterile, thick, yellow pus; but then healed. A bony tumor appeared in the right shoulder and humerus and grew rapidly. Death occurred nine months later.

Postmortem examination showed that the tumor of the right shoulder was a spindle-celled osteosarcoma. The right scapula, humerus, and clavicle were imbedded in the tumor which contained bony and cartilaginous areas and which tended to overlie the normal bone. There was bony union between the radius and the carpal bones with nodular bony thickening in the interosseus membrane. Everywhere there was extensive bone formation in the joint capsules, muscles, ligaments, tendons, interosseous membranes, and arachnoid. A definite thyroid tumor, aplasia of the bone marrow, and normal chemical analysis of the bones were observed.

It is noted that the lesions found were those found in three bone disorders. In progressive myositis ossificans an hereditary element is present as in this case. The hypothesis is offered that there was an error in the development of one of the chromosomes,

giving the picture also found in diaphyseal aclasis. There was also evidence of acromegaly. The case is reported with the hope that it will tend to throw light on the nature and possible interrelationship of these three diseases.

A Report on a Specimen of Spondylolisthesis Found in the Skeleton of a Bantu Native of South Africa: with Further Specimens Illustrating an Anomalous Mode of Development of the Lower Lumbar Vertebrae. L. R. Shore. *British J. Surg.*, XVI, 431, Jan. 1929.

A skeleton is described in which there was displacement of the body of the fifth lumbar vertebra downwards and forwards to a position in front of the sacral promontory. The dorsal arch is displaced forward to the usual position of the body. The body rests on a bony shelf on the sacrum. The dorsal arch has separated by division of the laminae between the superior and inferior articular processes.

Four other specimens are described in which there is a congenital division of the laminae, which, it is suggested, may be the cause of the dislocation of the body forward from the arch, or which may be an antecedent factor, leading to its occurrence from trauma or disease.

A Case of Extensive Pulmonary Embolism Following Fracture. V. Cotton-Cornwall and C. W. Ponder. *British Med. J.*, II, 789, Nov. 3, 1928.

Cotton-Cornwall and his associates report a case of extensive and fatal pulmonary embolism following fractures. The patient, an adult female, age forty-three, suffered a fracture of the left tibia and fibula. The fracture was treated by fixation in plaster-of-Paris. When examined six weeks later, the fracture was soundly united in good position, but was accompanied by considerable degree of oedema of the ankle and leg. There was a good deal of limitation of movement of the ankle and knee. The following day, on getting out of bed, she collapsed suddenly and died. Postmortem examination revealed the right ventricle and pulmonary artery to be occluded by a large clot. This was thought to have been derived from the left iliac vein. They express the opinion that thrombosis in the iliac vein could have been prevented had massage and passive movements been carried out.—*R. I. Harris, M.B., Toronto, Canada.*

On the Treatment of Fractures. E. W. Hey Groves. *British Med. J.*, II, 993, Dec. 1, 1928.

Hey Groves devoted his presidential address to the British Orthopaedic Association to a plea for special units for the treatment of fractures in all centers. He outlines a plan for the establishment of such units in teaching hospitals, in municipal hospitals and in smaller hospitals.—*R. I. Harris, M.B., Toronto, Canada.*

An Achondroplastic Twin. Allan Warner. *British Med. J.*, II, 283, Dec. 1, 1928.

Warner reports an interesting case of achondroplasia occurring in one of twin boys. The achondroplastic condition was present at birth in the affected child. His twin brother was normal in every respect and somewhat taller than the average for his age (sixty and one-half inches at ten and one-half years while the achondroplastic child was forty and one-half inches). Warner concludes that the occurrence of achondroplasia in one of twins definitely disproves maternal infection or anomalies of internal secretion as a causative factor, since either of these should have affected both of the twins. He concludes that his patients are not identical twins and that achondroplasia has appeared in one as an inherited characteristic.—*R. I. Harris, M.B., Toronto, Canada.*

Fractures of the Lower End of the Radius in Adults. Harold Edwards and E. Bellis Clayton. *British Med. J.*, I, 61, Jan. 12, 1929.

The authors made an analysis of 424 cases of fracture of the lower end of the radius: 251 of these fractures were in women and 173 in men and boys; 339 fractures were of the Colles' type and eighty-five were backfire fractures caused by backfire injury while crank-

ing an automobile. In 158 of the 339 cases of Colles' fracture there was also a fracture of the ulna. In all but eight of these the fracture was of the styloid process. Fracture of the ulna appears to make little difference in the end results. In fact, patients in whom there was no fracture of the styloid process were more likely to complain of tenderness over the internal lateral ligament than those in whom fracture of the bone had occurred.

The routine treatment used by the authors is reduction of the fracture under gas anaesthesia and the application of a wooden splint holding the wrist straight or in slight flexion. The fingers are left free and the patient is encouraged to move them from the outset.

Great emphasis is placed upon complete correction of the backward tilt of the lower fragment and the radial deviation. In the authors' experience an uncorrected backward tilt invariably results in a weak wrist. This weakness may be due to the fact that the flexor tendons cannot act along their normal straight line, or, as Mr. Fairbank has pointed out, the pull of the long extensor tendons may make the carpus slip backward over the oblique radial articulation. Late cases of backward tilt may require an osteotomy to obtain a good result. An uncorrected radial deviation may not cause immediate disability but since it upsets the normal mechanism of the wrist, the joint is predisposed to arthritis in later years.

Following the reduction, massage is started during the first week in old patients and the second week in younger patients. The average duration of treatment for all cases was nine and a half weeks, including a number of chronic patients who attended the physiotherapeutic department for several months.

In 321 cases the late results were obtained by questionnaire. In 235 (73.2%) there was no complaint of any kind; seventy-four (23.1%) complained of occasional stiffness, aching after use, or other minor complaints,—twenty-three of this group had arthritis of the wrist or finger joints before injury and, no doubt, some of them developed it since injury. All of this group resumed their normal occupations. The remaining twelve cases (3.7%) were failures. In analyzing this group it was found that a pre-existing arthritis was the cause of failure in three cases and backward tilt of the lower fragment with resulting weak wrist in three cases. One case attended the clinic for a few days and then disappeared and another case had an operation elsewhere with resulting median nerve palsy. In the remaining four cases no cause for failure could be found. —*E. W. Cowart, M.D., Iowa City, Iowa.*

Occupational Pressure Neuritis of the Deep Palmar Branch of the Ulnar Nerve. Wilfred Harris. *British Med. J.*, I, 98, Jan. 19, 1929.

Harris reports two cases of paralysis of the deep palmar branch of the ulnar nerve due to occupations involving prolonged pressure upon the palm of the hand. One case occurred in a leather cutter in whom the constant use of a knife in cutting resistant leather had raised horny callosities on the hypothenar eminence. The second patient was a motor cyclist who was accustomed to grasp tightly the handle bars of his machine on long and rough rides. Both patients had paralysis of the small muscles supplied by this branch,—*i.e.*, interossei and lumbricales, and the deep head of the adductor pollicis. There were no sensory changes.—*R. I. Harris, M.B., Toronto, Canada.*

Curettage of the Bodies of the First and Second Sacral Vertebrae by Median Posterior Route. Louis Ménard. *Bull. et Mém. Soc. nat. de Chir.*, LIV, 1031, July 1928.

The case was of a tuberculous osteitis of the sacrum, with many fistulas of several years' duration. A radiograph taken on the face demonstrated the presence of a sequestrum in the center of the second sacral vertebra. Ménard reached the lesion by the post-median way, and performed a laminectomy of the second, third, and fourth sacral vertebrae, saving the posterior arc of the first. He also uncovered the nerve

elements, following the sacral routes, maintained in place by the *filum terminale* and the coxalgic nerves. The operator cut the *filum terminale* and the coxalgic nerves, which allowed a certain amount of retraction of the meningeal cul-de-sac and allowed exposure of the bone surface, free from the nerve elements. This surface corresponded to the second sacral body. Ménard then performed a trephination of the spongy portion of this body and reached the anterior portion of the sacrum, and through the osseous canal reached the anterior surface of the sacrum and found the cavity and the sequestrum. The wound was drained, the recovery from the operation was normal and terminated in cicatrization of the sinus after several months.—*Jacques Calvé, Berck-Plage, France.*

Tuberculosis of the Hip in a Seaside Hospital for Heliotherapy. (Statistical studies; radiographic indications; methods of cure.) A. Mezzari. *Chir. d. Org. di Movimento*, XII, 313, July 1928.

The author, who has been able to follow in a complete manner in hospital work 356 cases of coxitis, reports upon the particular clinical aspects of these affections from the initial symptoms to the results.

The work is divided into three sections: statistical researches, radiographic studies, methods of cure.

He reviews the entire therapeutic armamentarium at the disposal of a large specialized hospital and reports upon the results of the various methods of cure. On the basis of the proofs furnished by these studies he evaluates the therapeutic effects and concludes that, according to his experience, even today in the era of heliotherapeutic miracles, in the cure of tuberculosis of the hip preference is to be given to the combination, (1) fixation (in good position by means of a plaster made by a skilled person) and (2) general heliotherapy. He discusses the entire chapter of radiology of coxitis, stopping to comment upon the particular characteristic aspects of it, and sets forth in the clinical field as well as the radiographic field a discussion of great interest for the complete knowledge of this disease entity; that is, the various methods of cure.

He reports upon the final results obtained in his hospital and, setting forth with statistical data the better results obtained in patients who have begun treatment very early in comparison with those having treatment begun later, insists upon the great usefulness of a proper treatment of coxitis in specialized hospitals; but especially upon the necessity that this should be begun as early as possible without unjustifiable delays. —*Vittorio Putti, M.D., Bologna, Italy.* (*Translation by Murray S. Danforth, M.D., Providence, R. I.*)

Experimental Studies on the Bone Atrophy of Sudeck. G. Segre. *Chir. d. Org. di Movimento*, XIII, 1, Oct. 1928.

Sudeck's bone atrophy is a particular form which occurs slowly or acutely in acute and chronic inflammatory conditions, in fractures, in distortions, in lesions of nerves or other soft structures, etc.

The outcome of the atrophy may be reparative or destructive. In order to contribute to the experimental evidence of the bone atrophy of Sudeck, the author undertook a series of experiments on rabbits, in which the inflammatory as well as the reflex, the inactivity, the metabolic and the vasomotor theories of the pathogenesis of this type of bone atrophy were investigated. In all cases it was found that at least ten days or two weeks of inactivity, produced by lesion of the tendons or by resection of the sciatic nerve were necessary in order to show Sudeck's atrophy in the os calcis. The signs of atrophy were always progressive but varied in intensity according to the nature of the determining factor. In the first stage one sees in the radiogram a thinning of the shadow in proportion to the lime salts absorption. Then comes the thinning out of the cortical substance with more or less marked destruction of the epiphyseal cartilage. The thinning out of the cortical substance and of the epiphyseal cartilage enlarges the medullary

cavity. The bone appears vacuolized: lacunar stage. In the course of time, when the underlying cause has subsided, reparative phenomena make their appearance, with new deposits of lime salts and with new formation of bone substance.

Concerning the pathogenesis of the condition, the author believes that among the various factors producing this type of atrophy, inactivity occupies the first place. The greater the inactivity, the more pronounced are the signs of atrophy; the sooner function is resumed, the more accentuated are the reparative signs.

However, in all cases in which inactivity obtained, other factors were added,—for instance, in resection of the sciatic nerve, the paralytic symptoms which produced inactivity were complicated by sensory and trophic disturbances.

In one case, for instance, resection of the nerve was followed by extensive ulceration of the forefoot, resulting in bone atrophy of very marked degree. Circulatory disturbances, nervous disturbances, inflammatory causes, traumatism, oedema were found to be definite factors in the production of Sudeck's atrophy.—*A. Steindler, M.D., Iowa City, Iowa.*

THE METACARPOPHALANGEAL GANGLION. M. Bufalini. *Chir. d. Org. di Movimento*, XIII, 29, Oct. 1928.

This is a ganglion which has its constant seat at the digitopalmar fold, or better between the latter and the metacarpophalangeal articulation. Clinically, the condition is characterized by the presence of a small, regular, round tumor of firm, elastic consistency. It is most often found in young women. The patients complain of slight tenderness upon pressure or tension of the tendon; in other cases there is spontaneous pain radiating over the entire forearm.

The author calls special attention to the movability of the tumor in lateral direction, while in longitudinal direction it is usually fixed.

Of particular interest is the relation of the ganglion to the tendon sheath of the flexor muscles and to the metacarpophalangeal articulation. The observations of the author confirmed the findings of Sonntag, who emphasized the connection of the ganglion with the tendon sheath.

The differential diagnosis is discussed shortly.

Tumors of the tendon or of the sheath can be easily excluded with the exception of small fibromas of tendon or sheath. Other conditions of differential diagnostic interest are traumatic epithelial cysts, incapsulated hematoma, neuroma. More easily are excluded postinflammatory adhesions of the tendon with the skin or the bones. Relative to the pathogenesis, the author leaves open the question of retention cysts following herniation of the sheath or the articular synovia, as well as that of circulatory disturbances in the sense of an endarteritis obliterans (probably traumatica) favoring degenerative processes with oedematization of the tissues.

Trauma is considered a factor of importance by the majority of observers; and here it is more the duration and persistence, than the intensity of the traumatic agency. Occupational strains in housekeeping chores have been accused, but they most likely are merely concomitant causes considering the low frequency of the condition. The author considers that part of the cases are primary or essential, part of them secondary or symptomatic ganglion formations, the latter following a tendovaginitis.

The definitely located seat of the ganglion at the digitopalmar fold points to predisposing anatomical conditions. This the author sees in the interruption of the palmar fascia with a weak point at the level of the articulation, favoring the formation of the ganglion. The synovial sheaths of the second and fourth finger tendons are different from the first and fifth, and end at the metacarpophalangeal articulation, with a sort of cul de sac—another predisposing factor.

The treatment of this type of ganglion does not differ from other ganglia. Spontaneous cure is a possibility. Surgical interference (excision of ganglion) is to be considered in particularly painful cases. The simplest way is the crushing (as practiced in other ganglia), although there is a high rate of recurrences. In cases in which the gang-

lion is symptomatic of a tendovaginitis, extirpation is of no avail as long as the synovial process in the tendon has not come to a standstill.—*A. Steindler, M.D., Iowa City, Iowa.*

ARTICULAR CHONDROMATOSIS OF HENDERSON-JONES. G. Ricciuti. *Chir. d. Org. di Movimento*, XIII, 39, Oct. 1928.

In free bodies of the joint one distinguishes between bodies of traumatic origin, free bodies of osseous origin, and those of synovial origin. The question of osteochondromatosis of joint already considered by Virchow and later by Lexer, was taken up more recently by Henderson and Jones. These authors stated that some joints had a pathological habit of producing loose bodies in such numbers that osteochondromatosis best described the condition. It is a joint affection of slow and insidious development, mostly painless, monarticular, preferring knee or elbow, although other localizations are possible. Osteocartilaginous bodies may, at the same time, be present in the bursae surrounding the joint. They have also been found in the tendon sheaths, especially of the flexors of the hand. The joints are filled with a great number of these bodies of various sizes, the capsule is distended, the synovia hyperaemic and covered with fibrous exudate. The bones and articular surfaces are usually intact. A case in point is reported.

Henderson's chondromatosis represents a clinical entity, characterized by the presence of these numerous bodies, which in structure much resemble true chondromas and which are indeed to be considered as benign neoplasms. Chondromatosis is also distinct from arthritis deformans; arthritic symptoms appear only secondarily. Simple arthrotomy and removal of the bodies ordinarily effects cure.—*A. Steindler, M.D., Iowa City, Iowa.*

STREPTOCOCCI IN THE SPINAL FLUID IN ACUTE EPIDEMIC POLIOMYELITIS. Edward C. ROSENOW. *J. Am. Med. Assn.*, XCI, 1594, Nov. 24, 1928.

Gram positive diplococci of varying size and shape arranged singly, in short chains, or in small clumps, have been found in stained smears, made from the sediment of the spinal fluid in each of eighteen consecutive cases of poliomyelitis that occurred recently in an epidemic near Rochester, Minn. These organisms also have been found in the spinal fluid in each of three monkeys in which typical poliomyelitis followed intracerebral inoculation of emulsions of brain and cord from three patients who died. Control cases did not show these organisms.

Growth on special media was obtained in all but three of the eighteen cases. The organisms were agglutinated specifically by the hyperimmune poliomyelitis antistreptococcus serum.—*W. E. Grieve, M.D., Iowa City, Iowa.*

COMPRESSION FRACTURE OF THE VERTEBRAE. C. F. Eikenbary. *J. Am. Med. Assn.*, XCI, 1694, Dec. 1, 1928.

Dr. Eikenbary gives the mechanism of compression fracture as a forcible forward flexion of the spine. Fracture may be caused by an apparently trivial injury.

A stereoscopic anteroposterior view or a clear lateral is necessary for a diagnosis. Dr. Eikenbary believes that a case that could have a compression fracture should be treated as one unless the condition can be proved to be something else. In spite of the fact that the diagnosis is rather easy, it is too common to have cases overlooked for a long period of time. Failure to make a correct diagnosis shortly after the injury is probably the most potent factor concerned in the poor results obtained.

The author advises treatment on a slightly curved frame or in a plaster shell. If a shell is used it should extend from the head to the knees. He does not believe that an ordinary plaster jacket is sufficient to hold these patients. He advocates at least three months recumbent treatment and the patient should have some type of support for at least a year following the injury.

Dr. Eikenbary says that not a single case that he has examined has been cured by fusion of the spine. Some of them were better, some had less disability than before, many had less pain, but all had a very large percentage of disability. He believes that a fusion operation must be done early if any good is expected to come from the procedure.

The prognosis depends upon the occupation of the individual. In private cases the treatment seems to be satisfactory and gives a fair proportion of good results. The private patient is usually engaged in a rather sedentary occupation and is always anxious to get well. For financial reasons the state or industrial patient may prefer to have his disability drag on as long as possible. Of nearly two hundred cases, he reports that less than five have gone back to hard labor without a considerable percentage of disability.

Dr. Eikenbary summarizes his paper as follows:

1. This paper is based on the study of 131 cases plus the knowledge gained from examining the records in seventy-five other cases.

2. Early diagnosis is the most important step in the treatment.

3. Rest in bed for three months, followed by the wearing of a well fitting brace for at least one year is the treatment of choice.

4. Fusion operations certainly have some place in the treatment, particularly if performed early, but their value is greatly overestimated, and they should by no means be a routine procedure.

5. Industrial insurance patients form a different group from private patients for two reasons: (a) the psychological element is apt to be wrong, and (b) private patients are not likely to belong to the class that must go back to hard labor.—*W. E. Grieve, M.D., Iowa City, Iowa.*

THE RELATIONSHIP OF HYPERTHYROIDISM TO JOINT CONDITIONS. W. S. Duncan. *J. Am. Med. Assn.*, XCI, 1779, Dec. 8, 1928.

Endocrine joint rheumatisms are rare in literature. Fifty cases in which there is a definite relationship to rheumatism are reported. It is a common experience to have patients with hyperthyroidism complain of rheumatism.

All cases were hospitalized and had pre-operative treatment. All patients failed to respond to anything but most radical treatment.

Case 1. Lawyer, age fifty-five, complaining of nervousness, weakness, and loss of weight, had noticed heart rate becoming more rapid. He did not notice a goiter. Basal metabolism ran between forty per cent. and sixty per cent. above normal. Was given rest and iodin in several forms. While in hospital developed rheumatism, right shoulder and arm. Rest, salicylates, iodin, and other treatment were of no avail. Twelve days after entering hospital, ligation of both superior thyroid arteries was performed. A few days later arthritic signs developed in left shoulder. Patient was sent home for three months and on return complete thyroidectomy was done. Gland was adenomatous type. The striking features of this case were the progressive periarticular changes noted prior to operation, irrespective of treatment. Within forty-eight to seventy-two hours following operation, severity of pain lessened almost miraculously. Three weeks later patient wrote that arthritis was slowly but surely clearing up. Six months later patient wrote that all arthritis had entirely cleared up except slight stiffness in right hand.

Another similar case with plus sixty-six per cent. metabolic rate reported, also with hypertrophic rheumatism which showed the same marked benefit following operation.

Similar cases reported show striking relation between thyroid toxaemia and rheumatism. Basal metabolism ranged between plus twenty-two and plus eighty-eight and the severity of rheumatism seemed to be in direct proportion to the severity of local inflammation or effusion. Some reports of satisfactory treatment of such cases with x-ray have been made, but all of the author's cases were treated by operation. The author states that he has yet to see a patient suffering from this typical disorder who was not relieved by thyroidectomy.—*W. B. Carrell, M.D., Dallas, Tex.*

END RESULTS OF EXTRA-ARTICULAR FIXATION OF THE TUBERCULOUS HIP IN CHILDREN. F. C. Kidner. *J. Am. Med. Assn.*, XCI, 1865, Dec. 15, 1928.

Dr. Kidner believes that tuberculosis of the hip does not heal with useful motion. In case of fibrous union the disease may be awakened by any trauma.

The author reviews the various methods that have been used for operative fixation of the hip. He believes the Hibbs method the most rational and widely applicable. This consists of the rotation and transplantation of an osteotomized vertical wedge from the greater trochanter, without removing the muscle attachments, so that it has bony contact with its own stump, with the roughened superior surface of the femoral neck, and with a trap door groove in the side of the ilium. Periosteal continuity is maintained superficially. The transplant is held in place by the compression of the forcibly abducted upper end of the femur.

Seventeen cases operated on up to October 1927 are reported. A variation from the true Hibbs technique, which consisted of using free grafts from the trochanter and upper end of the femur, was used in most of the cases. Bony union did not occur in five cases. Of these one was considered non-tuberculous and to have joint cartilage remaining. In two cases the grafts were placed in the presence of free pus and there was widespread bone destruction. In one case the graft was fractured or there was an epiphyseal line from the trochanter in the graft. The graft was weak in the other case.

Good function was present in all but two cases and the progress of the disease had been stopped in all cases. Patients operated on ranged in age from four to fourteen years: duration of symptoms from one and a half to eleven years.

Dr. Kidner does not believe activity of the disease is a contra-indication to operation. In no case was there a flare-up of the disease following the opening of active pockets of the disease, nor a case of systemic dissemination of tuberculosis.

The fact that free pus and granulation tissue existed, widely spread through the field of operation, did not prevent primary healing. Free pus was encountered in five cases. In three cases union went on satisfactorily in spite of pus. In two cases union was still absent after twelve months, but symptoms had disappeared and new bone was formed. There was no further bone destruction. All cases were treated in double hip spicas for from three to nine months.

Dr. Kidner's conclusions were as follows: (1) assuming that tuberculosis of the hip does not heal without fixation, operative fixation should be done as early as possible, as regards both the age of the patient and the duration of the disease; (2) the extra-articular operation provides a means for early fixation; (3) the juxta-articular method of Kappes and Hibbs and the free graft described in this paper provide a better means than the para-articular methods of Albee, Calvé, and others: (4) it is safe to operate in the presence of active tuberculosis even with abscess, if there is no open sinus; (5) even though fixation does not occur promptly after the operation, the graft provides an internal splint which relieves symptoms and prevents spread of the disease; (6) the operation in no way interferes with growth. Shortening following the operation is only that present before the operation. If the growth center has been destroyed before operation, relative shortening will increase after operation; (7) flexion of twenty to forty degrees in mid-position is the position of choice for these fixed hips; (8) the earlier the operation is done in proved tuberculosis of the hip, the less will be the shortening and the shorter the period of invalidism.—*W. E. Grieve, M.D., Iowa City, Iowa.*

FRACTURES OF THE CLAVICLE. E. L. Eliason. *J. Am. Med. Assn.*, XCI, 1974, Dec. 22, 1928.

The clavicle is one of the most frequently broken bones of the body. Statistics show that from five to ten per cent. of all fractures occur in the clavicle. Authors variously state that from thirty to fifty per cent. of these occur under ten years of age. This is due to the early ossification of the bone plus the unusually thick periosteum, at a time when all other bones are flexible.

The clavicle is the only bony connection between the trunk and upper extremities and is subject to much trauma, and all falls on the upper extremities are transmitted to this bone. The diagnosis in adults is made from a history of trauma, local pain, and tenderness, and the typical angular deformity with overlapping, the shoulder being downward, forward, and inward. With children the forearm flexed to a right angle at

the elbow is supported and pushed upward by the other hand. Crepitus and abnormal mobility are readily demonstrated. Sometimes there is some difficulty in diagnosing these fractures in smaller children.

In treatment of this fracture, the deformity and the factors that cause it, which are chiefly muscle pull and gravity, must be understood. Any number of dressings and methods of fixation have been described, showing that an entirely satisfactory way has not yet been found that will be comfortable, restore function, and minimize deformity. There need be no fear of non-union, as union occurs despite the fact that fixation is not complete. Incomplete or greenstick may be handled with a Velpeau or Sayre dressing or any of their many modifications. These should have protection for about three weeks; then a sling for another week. These dressings all act to force the shoulder upward, outward, and backward, and to hold it there. The contour of the rib is such that if the shoulder is pushed back, it will of necessity be pushed up.—*W. B. Carrell, M.D., Dallas, Texas.*

STUDIES IN RICKETS. III. PREVENTION BY MEANS OF ULTRAVIOLET IRRADIATION. T. K. Selkirk, J. V. Greenebaum, and A. G. Mitchell. *J. Am. Med. Assn.*, XCI, 2057, Dec. 29, 1928.

The cure of rickets by ultraviolet-ray irradiation as demonstrated by Hyldschinsky ten years ago has since been confirmed by hundreds of investigators. Our next step was to ascertain if irradiation could be used as a preventative of rickets; if so, the amount and intervals of treatment necessary.

Diagnosis was made by x-ray picture taken of left wrist of a group of infants monthly until the age of eight months. These babies were divided into four groups for treatment as follows: (1) ultraviolet, (2) ultraviolet and cod-liver oil, (3) cod-liver oil and (4) neither ultraviolet nor cod-liver oil. Seventy-seven per cent. of the latter in colored and seventeen per cent. white babies developed rickets. Fifty-seven per cent. of cases diagnosed by x-ray showed rickets on clinical examination and diagnosis was made by x-ray before there was any clinical evidence. Fifty-one per cent. of group were female, forty-nine per cent. male; seventy-nine per cent. colored, twenty-one per cent. white; seventy-nine per cent. breast fed. Babies born from December to April show slightly lower incidence of rickets than those born during remainder of year.

Group 1. Prevention in ninety-eight per cent. of cases to age of eight months with eleven minutes per month of ultraviolet ray.

Group 2. Same result as Group 1 with six minutes per month.

Group 3. Prevention in sixty-one per cent. Record kept showed cod-liver oil given irregularly and in small doses. The average age when the irradiation was started was one and six-tenths months and continued for an average of six months' time.—*W. B. Carrell, M.D., Dallas, Tex.*

OPERATIVE FUSION FOR TUBERCULOSIS OF THE SPINE. M. S. Henderson. *J. Am. Med. Assn.*, XCII, 45, Jan. 5, 1929.

The author reports on 301 cases fused and observed for from two and a half to fifteen years.

The bone graft method of Albee was used in 269 cases and Hibbs' operation in thirty-two.

The age in decades was as follows:

From one to ten years, sixteen patients; from eleven to twenty, eighteen; from twenty-one to thirty, 147; from thirty-one to forty, eighty; from forty-one to fifty, thirty-three; and from fifty-one to sixty, seven.

Tuberculosis was present elsewhere in the body in 101 cases; in sixty-five roentgenograms and physical signs afforded evidence of involvement of the lungs. In thirty-six cases tuberculosis was elsewhere chiefly located in the genito-urinary tract. In these cases preference was given to surgical procedures on the urinary tract, the spinal fusion

being performed later. Pulmonary cases were not operated on until the lesion in the lung was either healed or quiescent, and examination of the sputum was negative.

The lesion was in the cervical region in one case, in the dorsal region in 121 cases, in the dorsolumbar region in forty-five, and in the lumbar region in 134. Eleven cases with more or less complete paraplegia were operated on. One had an excellent result; three, good results; three, fair results; and one, a poor result; one died and two were not traced. In several cases following the Hibbs fusion the paralysis cleared up with astonishing rapidity. The results in 137 cases (51.8%) were good. Twenty and four-tenths per cent. of the patients operated on had died. Three postoperative deaths occurred. These include 1 pulmonary embolism three weeks after operation, one due to shock, and one to meningitis five weeks after operation.

The recumbent treatment was necessary to complete the convalescence in the cases in which the result was satisfactory—it is nearer two years than one, often extending to three years. The patients who were able to take good care of themselves, were getting plenty of rest, open air, and so improved much faster.

The postoperative care in all cases consists of rest on a Bradford gas-pipe frame for at least six weeks and often for as long a time as ten or twelve weeks, and the wearing of a brace or cast for at least one year from the time symptoms cease. Heliotherapy in the summer, lamps in the winter, and tonics are included in the aftercare. A good general dietic and hygienic regime is insisted upon.

Dr. Henderson states that the operation has not been satisfactory in children, but does not discuss his reasons for this opinion. The results were better in cases in which the lumbar region was affected than if the lesions were elsewhere; while in Hibbs' series of children, results were more favorable when the dorsal region was affected.

Summary of Results.

	Excellent	*Good*	*Fair*	*Poor*	*Fatal*	*Total*
Cases.....	89	48	41	32	54	264.0
Per cent.....	33.7	18.1	15.5	12.1	20.4	99

Conclusions.

Operative fusion has a definite value in cases of tuberculosis of the spine. If an adult patient is in good general condition, and if there is no evidence of impending wide dissemination of the disease or draining sinuses that are likely to cause contamination of the operative field, an operation which will cause fusion of the diseased area is justifiable.—*W. E. Grieve, M. D., Iowa City, Iowa.*

Malunited Fractures and Unreduced Dislocations about the Elbow. Willis C. Campbell. *J. Am. Med. Assn.*, XCII, 122, Jan. 12, 1929.

Reconstruction procedures must be devised to meet individual cases, but some general principles should govern work of this character. The aim should be to restore the normal carrying angle of the elbow and to increase the range of motion, but with due regard to stability. The condyles should be preserved and placed for union in proper relation to the shaft and with the articular surfaces directed for normal relation to the radius and ulna. Masses of bone and callus which interfere with joint motion should be excised, avoiding, when possible, the sacrifice of the massive distal end of the humerus because of its essential value in securing stability.

In children, the freshened condyle should be carefully replaced for union with the shaft. Otherwise, deformity will increase with growth changes in the arm. This is more common in injuries of the external condyle, and the cubitus valgus frequently becomes so marked that instability results, with perhaps nerve irritation and, in some, extensive ulnar palsy. In adults, more liberties can be taken with detached fragments, as the problem of future growth is not in question. A portion of the condyle can be removed, the bone mass reshaped, and, in effect, a partial arthroplasty may give an excellent result.

Reconstruction in T-fractures may be done by restoration of the fragments, if ankylosis has not occurred, with expectation of fair function. When ankylosis is present in adults, it is better to do an arthroplasty. In replacing fragments and maintaining new positions, bone pegs and small grafts are freely used and have a distinct value.

Old dislocations: Closed reductions should not be attempted when two or three weeks have elapsed since injury. Open reduction gives good results, especially in children, up to two months after injury. In old dislocations, arthroplasty for adults is a better operation.—*W. B. Carrell, M.D., Dallas, Tex.*

SYMPATHETIC RAMISECTION IN SPASTIC PARALYSIS: A Report of Forty Cases from the Service of the New York Orthopaedic Dispensary and Hospital. H. LeRoy Von Lackum (Dr. Von Lackum died June 30, 1928). *J. Am. Med. Assn.*, XCII, 139, Jan. 12, 1929.

The author, in 1926, reported good results from ramisection in spastic paralysis, and after two years' further study and observation on forty cases was more firmly convinced that ramisection in suitable cases is the best treatment so far suggested for spastic paralysis.

Indications are more definitely outlined in the author's last article, and emphasize the mental requirement which will permit the child to have some appreciation of the plan of treatment and be able to attempt motions and exercises as directed. Children of younger age who did not have fixed habits of deformity gave better results. The element of plastic tone was not so important as formerly thought. Good results were measured not so much by physiological reactions but based on behavior of the child before and after operation. Scissor limbs were changed to legs in good position. Children who before operation walked with bent knees, walked straight after operation. Those who tired easily and had marked stiffness in their legs could walk long distances afterward. One child, who had never done this before, was found holding a toy in his hand two days after cervical ramisection. The teachers, mothers, and patients were pleased, and convinced that improvement was definite and due to the operation.

This paper is the last contribution of our dear friend to the literature of orthopaedic surgery. In that frank and persuasive style which characterized his clinical teaching, he has given us honest convictions about a work which attracted much of his interest and study during the past several years.—*W. B. Carrell, M.D., Dallas, Tex.*

DISPLACEMENT OF THE UPPER FEMORAL EPIPHYSIS. Carl E. Badgley. *J. Am. Med. Assn.*, XCII, 355, Feb. 2, 1929.

Summary of twenty-seven studied cases:

Chief among the problems to be solved are cause, pathology, fate of untreated cases, and treatment.

Many theories have been advanced to explain the etiology of the lesion,—endocrine dysfunction, trauma, and faulty statics—but no one factor is present in all cases. Anatomic changes, appearing at adolescence,—namely, thinning of the periosteum and the assumption of a more vertical position of the epiphysis on the femoral neck—should be classed as predisposing factors. Another anatomic factor is the mechanism of extension. At fifteen degrees hyperextension the femoral head is locked in the cavity and further extension will produce strain at the epiphysis. Rapid growth, plus obesity, with the anatomic variations described, make the epiphysis vulnerable to the frequent strains at this period.

Treatment: Manipulation when malunion or non-union is present should not be done. Early cases in the pre-slip stage should be treated in abduction and slight internal rotation. After six weeks a walking caliper may be substituted. Cases with recent displacement may be manipulated by the Whitman method,—plaster bivalved in three weeks for massage, and motion started in six weeks. If four months have

elapsed since displacement, manipulation should be omitted. In old cases with malunion, the double osteotomy of Wilson is the method of choice.—*W. B. Carrell, M.D., Dallas, Tex.*

LUXATION OF THE COSTOVERTEBRAL JOINTS. Steele Stewart and J. W. Warren. *J. Am. Med. Assn.*, XCII, 605, Feb. 23, 1929.

A man, age fifty-five, received a crushing blow against the left shoulder and complained immediately of numbness and paralysis in the fourth and fifth fingers. Roentgenograms disclosed a fracture in outer half of the clavicle and rotary dislocation of the vertebral end of the first rib. The position was a downward subluxation of the rib at the transverse process and an upward position of the head on the body of the vertebra. At operation the rib was replaced by traction and leverage, and reduction accompanied by an audible click. The existing pressure on brachial plexus was relieved, with restoration of normal relations and complete recovery for the patient.

Very few cases have been reported, and most of those associated with severe lesions of adjacent structures. The diagnosis is suggested by neurological symptoms and made from study of roentgenograms.—*W. B. Carrell, M.D., Dallas, Tex.*

L'OSTEOMYELITE VERTÉBRALE. Raymond Leibovici. *J. de Chir.*, XXXII, 648, Dec. 1928.

This article is a study of infectious spondylitis alone, not a particularly rare disease. As early as 1879 descriptions of it were given. For the most part the adolescent and infant—and men rather than women—are exposed to vertebral osteomyelitis. The causative agent is the staphylococcus aureus, rarely staphylococcus albus or streptococcus. Traumatism is naturally named as the causative agent but the real rôle played by traumatism is a delicate one to solve, since severe osteitis evolves slowly and is not discovered till long after the accident. The lumbar column is most often attacked; vertebral osteomyelitis in most cases leads to the formation of an abscess. Extra-spinal abscesses are most frequent. They stretch out along the lateral vertebral groove, in the muscles of the lumbo-sacral mass. Intraspinal abscesses are relatively frequent and are especially dangerous.

The clinical course ranges from fatal cases with pyemia or cachexia, to mild cases which clear up after the opening of the small periostial abscess; but on the whole, the condition usually gives a grave prognosis. The author reports cases of various types, from his own clinic, and from the literature. The onset of this disease is often acute, with signs of severe general infection; acute pain in the back which may radiate to the chest or abdomen. The patient refuses to move in bed. There is reflex spasm of the back and tenderness over the diseased area. At the end of the first week there may be local oedema and the abscess may appear subcutaneously. The author emphasizes the fact that complications are numerous and frequent. Meningitis, myelitis, and intraspinal abscesses are especially to be feared. Lumbar puncture is to be done with great care when one suspects osteomyelitis of the spine, as one may in this manner cause a fatal meningitis.

If the diagnosis is definite, the treatment is surgical. The abscess is opened, and it may be necessary to perform a laminectomy in order to reach intraspinal abscesses. The laminae or the bodies of the vertebra may be curetted. Results are discouraging, but the intervention is necessary and occasional cases can be cured. Vaccines are recommended in chronic cases as an adjuvant to surgical treatment.—*J. A. Key, M.D., St. Louis, Mo.*

A SIMPLE METHOD OF PERFORMING ARTHROPLASTY IN TRUE ANKYLOSIS OF THE JAW. Arnold K. Henry. *Lancet*, II, Sept. 29, 1928.

In excising the tempero-mandibular joint, the author uses the Hudson drill for the following reasons: (1) it can be used in a cramped field, thereby preventing stretching of the facial nerve; (2) it joins as soon as it perforates, and does no injury to brain or

blood vessels. He makes an incision along the lower border of the zygomatic arch, beginning just in front of the temporal artery, and extends it forward one and one-half inches. From the posterior border of the incision he makes a second incision at right angles to the first and extending upward four inches. The joint is exposed by displacing the posterior fibers of the masseter muscle downward and forward, and the ankylosing bone is removed with the Hudson drill. A flap of temporal fascia is interposed between the neck of the mandible and the site of the glenoid cavity and the wound is closed. The patients are encouraged to chew as soon as they have recovered from the anaesthesia. He cites one patient who had a bilateral ankylosis of the jaw for three years and who was able to chew meat on the fourth day after the second arthroplasty.—*E. M. Cowart, M.D., Iowa City, Iowa.*

Artificial Reconstruction of the Cotyloid Cavity in Congenital Dislocation of the Hip. Nové-Josserand. *Lyon Chir.*, XXV, 353, May–June 1928.

The author criticizes the ordinary procedures which are employed for reshaping the roof of the acetabulum, and for not sufficiently lowering this artificial cavity. He has proposed the following procedure, which consists of artificially reenforcing those structures which, normally, reconstruct the luxated hip after the reduction. He calls attention to the important rôle played by different parts in the process of the reconstruction of the hip after bloodless reduction. The cotyloid cavity of the child is not formed by bone but by cartilage, and at the age of seven years the bony structure is but a small, thin portion of the cavity; it is the fibro-cartilage which is the principal means of securing the solidity of the hip. After a reduction the stability is maintained at the first by the capsule, of which the superior portion is folded on itself and retracted. This retraction carries over the femoral head the fibrocartilage, which is pressed upon by the exposed head and covers the surface of the newly formed cotyloid cavity. It exerts there a strong resistant action, which is the principal agent in maintaining the head in place. When the treatment is finished, the limb returns to its position easily and the child resumes walking. The bony cotyloid cavity is formed only much later, and is seen by the radiograph to develop after several months or even after several years. Often it remains incomplete without the functions of the hip being interfered with, which proves the very important rôle which is given to the fibrocartilage in maintaining the stability of the hip.

But the fibrocartilage does not always return to its normal condition. Sometimes it remains adherent to the iliac bone and remains, therefore, exposed. In this, he thinks, lies the principal cause of the imperfect results. The object of these operations described by Nové-Josserand is to free the fibrocartilage, to lower it, and if need be to reenforce it by a graft. In order to accomplish this, the hip is reduced and the limb held in flexion beyond a right angle. The region of the hip is then exposed by Smith-Petersen incision. By this route the capsule is easily exposed. Then with a strong gouge the surface of the bone is reamed out at the level of the evident insertion of the capsule. This is detached above and below from the fibrocartilage, which covers the new cotyloid cavity as far as is possible to feel with the finger on the femoral head in the bottom of the wound. On retracting as strongly as possible the soft parts to the outside, a kind of deep sac of five or six centimeters in length is exposed, of which the internal wall is formed by the iliac bone which has been reamed out, and the external wall by the capsule and by the fibrocartilage. It is in this sac that the osteoperiosteal graft, previously taken from the tibia, is placed. Care must be taken to place this graft as horizontally as possible,—that is to say, perpendicularly to the neck and to the projection of the bottom of the cavity. The wound is sutured and the hip is immobilized in abduction.

The operation is easy and brief. It does not expose the patient to shock, and immediate results are satisfactory. It remains, however, to see what may be the late results.—*Jacques Calvé, M.D., Berck-Plage, France.*

SYMPATHETIC TRUNK SECTION: A NEW OPERATION FOR RAYNAUD'S DISEASE AND SPASTIC PARALYSIS OF THE UPPER LIMB. Norman D. Royle. *Med. J. Australia*, II, 436, Oct. 6, 1928.

In Raynaud's disease and in spastic paralysis, ramisection has given considerably less relief in the upper than in the lower extremity. This is because the operation as first devised, failed to divide a sufficient number of sympathetic rami.

A new operation to overcome this, approaches through an incision which crosses the clavicular insertion of the sternomastoid muscle, exposing and partly dividing the sternomastoid and giving access to the scalenus anterior. A blunt dissector is passed behind the scalenus anterior and in front of the lower trunks of the brachial plexus, giving access to the upper part of the thoracic cavity. Following the first thoracic nerve as a guide, the sympathetic trunk is located as it crosses the neck of the first rib. The trunk is divided below the first thoracic ganglion, at a point between the first and second ribs; sometimes as low as the lower border of the second. The trunk is avulsed rather than cut.

The failure of cervical ramisection is due to incompleteness of operation. The author recites a case of Raynaud's disease in which the symptoms in the lower extremities were completely relieved by ramisection, but incompletely in the upper extremities. Two years later the right thoracic sympathetic trunk was divided below the first thoracic ganglion, whereupon the right arm was entirely relieved. Later a similar operation on the left was followed by like results.

Similar favorable results from the more complete operation are reported in spastic paralysis.—*Edward N. Reed, M.D., Santa Monica, Calif.*

CONCERNING THE SIGNIFICANCE OF ENLARGEMENT OF THE PARATHYROID GLAND IN OSTEITIS FIBROSA GENERALISATA RACKLINGHAUSEN. Ernst Gold. *Mitteilungen aus den Grenzgebrieten der Medecin und Chirurgie.* XLI, 63, 1928.

The author reviews the extremely interesting literature on the association of parathyroid enlargement with osteomalacia, osteitis fibrosa cystica generalisata and Paget's disease, and advises partial extirpation of the glands in osteitis fibrosa generalisata and osteomalacia. It is remarked that of seventeen cases of parathyroid enlargement encountered in autopsies of Maresch of Vienna, thirteen evidenced skeletal pathology. Of these thirteen, the diagnosis of "osteomalacia" was made on six, "osteitis fibrosa cystica generalisata Recklinghausen" on five, "osteoporosis" on one, and "osteitis deformans Paget with brown tumors and cyst formation" on one.

Gold's report concerns a fifty-four-year-old-female who suffered from osteitis fibrosa cystica generalisata Recklinghausen. A tumor of the right superior parathyroid gland was found at operation and extirpated. Six months after the operation, there had appeared a significant improvement, clinically, chemically, and roentgenologically. Microscopic examination revealed a benign adenoma. The blood calcium dropped from thirty per cent. above normal to a normal level. The previously abnormal excretion of calcium in the urine also underwent a profound drop in the direction of normalcy.

A bibliography is appended which will bear considerable profitable study.—*J. E. Milgram, M.D., Iowa City, Iowa.*

THE OCCURRENCE OF POLIOMYELITIS FOLLOWING TONSILLECTOMY. W. L. Aycock and E. H. Luther. *New England J. Med.* CC, 164, Jan. 24, 1929.

In 714 out of 1,224 cases of poliomyelitis, certain information regarding tonsillectomy was available. Seventy per cent. of these have tonsils present, thirty per cent. had had tonsillectomies prior to the poliomyelitis. Figures from the board of health of same area showed that thirty-two and nine-tenths per cent. of all school children examined had had tonsillectomies; therefore, the removal of the tonsils did not seem to influence the occurrence of poliomyelitis to any extent. Figures show that the interval between the tonsillectomy and the onset of the disease point to the fact that the disease

occurs most frequently within a year, furthermore, it occurs most frequently within a month of that year. Still more, the occurrence of poliomyelitis lies between the seventh and eighteenth days following the tonsillectomy—this corresponds to the supposed incubation time of poliomyelitis. The manner in which this operation may influence the occurrence of the disease is not known, but it is suggested that the disease may follow the operation for the reason that this procedure opens up the pathway of infection to the virus which may be present already in such individuals.—*C. S. Lowendorf, M.D., Iowa City, Iowa.*

THROMBOSIS OF PERIPHERAL ARTERIES FOLLOWING THE INTRAVENOUS INJECTION OF TYPHOID VACCINE—REPORT OF TWO CASES. A. W. Allen and R. H. Smithwick. *New England J. Med.*, Jan. 31, 1929.

Authors had given 300 injections of typhoid vaccine, fifty to arteriosclerotic patients without dangerous sequelae. Here is reported a case of arteriosclerotic diabetic patient with threatened gangrene who received 250 million bacilli intravenously. During the pre-chill stage of the reaction, when pre-existing pain is aggravated, the increase of pain was greater than at previous treatments and failed to subside in the normal manner, in spite of the fact that a chill came on and the temperature rose. A thrombosis of the femoral artery was found in a mid-thigh amputation. Another case is reported of a tabes dorsalis with extreme arteriosclerosis. He received seventy-five million bacilli. He had unusual amount of pain which outlasted the pre-chill stage. The foot and leg were cold and cyanotic; pulsation of popliteal artery disappeared. Under local anaesthesia a thrombus was removed with immediate relief of pain, but thrombosis occurred higher up and had to be removed. Still later another clot formed so that mid-thigh amputation was necessary. This patient recovered and was subsequently given six more intravenous injections of typhoid vaccine.

According to Dr. F. Fremont-Smith, who studied peripheral circulation following typhoid therapy, there is first a pre-chill stage during which the extremities are cooler, the pre-existing pain greater, the surface temperature less, the rate of blood-flow through the capillaries markedly diminished; secondly, in a half to two hours the chill occurs, lasting a few minutes to half an hour, with a sudden rise in body and surface temperature, and an increase, many times the normal, in rate of capillary blood-flow which continues long after mouth temperature has returned to normal. Dr. Fremont-Smith has also found that applying external heat to the extremities before injection may prevent the preliminary fall in rate of blood-flow.—*C. S. Lowendorf, M.D., Iowa City, Iowa.*

ON THE IMPORTANCE OF CLINICO-PHYSIOLOGICAL RESEARCH IN THE DIAGNOSIS AND THERAPY OF CHRONIC RHEUMATISM. J. Van Breeman. *New England J. Med.*, CC, 225, Jan. 31, 1929.

In this article, the author gives a very complete and lucid analysis of the various factors entering into the clinical entity known as chronic arthritis. He compares the German, English, French, and American literatures, reaching the following conclusions:

1. That the German schemes, which are principally anatomically orientated, contain valuable scientific data, partly suitable for international comparison. Causal factors, however, do not get their fair shares; most of all in the study of the orthopaedists.

2. That the French schemes are usually national in conception and contain valuable clinical data, in which pathogenesis also frequently gets its share.

3. That the conceptions of the English are mainly clinically orientated. The English Medical School in respect to arthritis reflects an old cult, in which the causal factors come into the foreground along different paths from those of the French.

4. That American medical men (orthopaedic surgeons and internists) have done important work of late years, and have furnished data accentuating especially pathogenesis. Where focal infection is not exclusively designated as the cause, these studies are very important from an international point of view.

Four factors always emerge in varying importance in the study of the international literature on this subject:

(1) Focal infection.
(2) Constitutional anomaly (arthritic diathesis).
(3) Abnomalities in circulation.
(4) External factors.

The author considers these from the viewpoints of each of the four schools, and concludes with the following statement:

"The problem of partial invalidity is important in that numbers of subjects of chronic rheumatism are rejected on applying for work, or thrown out of work, although in many instances the general health may be quite good in those cases where the disease has become arrested. It is obvious that better care of these cases at an early stage of the disease would avoid much of this partial disability and that the end result to the community would be of great significance.

It is the belief of the writer that if the Americans and English would lay less stress upon focal infections as the chief cause of arthritis and would pay more attention to the views of other schools, such as the Dutch and German, a broader angle of vision would be maintained, and opportunity would be removed for the criticism, from the Continental viewpoint, of the existence elsewhere of a single-minded attitude towards this great subject."—*Henry W. Lamb, M.D., Portland, Maine.*

Staphylococcus Septicaemia with Metastatic Osteomyelitis. J. P. Bowler and J. J. Boardman. *New England J. Med.*, CC, 327, Feb. 14, 1929.

A case of staphylococcus septicaemia is reported in which the blood stream infection was definitely proved prior to the onset and recognition of the osteomyelitic process in the long bones. This is reported mainly from the standpoint of treatment, and is the case of a child thirteen years old with a blood stream infection proved by blood culture. Three days after the positive culture an infection developed in the left clavicle, followed in the course of time by an osteomyelitis of the right clavicle, right tibia, and left femur, and numerous superficial abscesses.

The course of treatment consisted mainly of whole blood transfusions from donors who had been immunized against the patient's autogenous vaccine. The areas of bone infection were opened to the medullary cavity, packed, and left intact, as the authors felt that the Orr method offered the most satisfactory way of treating this overwhelming infection. They emphasize the importance of rest, prevention of deformity, and nursing care. The excellent treatment undertaken resulted in a cure after an illness of somewhat more than a year.—*Henry W. Lamb, M.D., Portland, Maine.*

Non-tuberculous Spondylitis. Dudley Carleton. *New England J. Med.*, CC, 320, Feb. 14, 1929.

Cameron presents a series of five cases of affection of the spine, all of which have followed some acute pulmonary infection. All cases were adults, and showed marked improvement in the condition in an average of one year. In three of the cases lumbar abscess was present.

X-rays in these cases show a destructive osteitis of both the body and the posterior structures of the vertebra. This differs from the destructive process of tuberculosis in that the posterior vertebral structures are more definitely involved than the body. Cultures from these cases revealed staphylococcus and pneumococcus.

In differentiating this condition from a tuberculous lesion, the following points are stressed:

1. X-ray shows a more general destruction of the vertebra, rather than the classical body destruction due to tuberculosis.

2. These cases show some acute, non-tuberculous type of pulmonary infection, preceding the onset of the back lesion.

3. Recovery is complete, and much more rapid than in those cases due to the tubercle bacillus.

The author emphasizes the importance of rest, immobilization, and general systemic upbuilding.—*Henry W. Lamb, M.D., Portland, Maine.*

WATER DRIP TRACTION. Prof. S. L. Tregubow. *Orthopedia i Travmatologia*, II, 14, 1928.

Traction applied in treatment of fractures may require a weight from two to eight kilograms, sometimes exceeding twenty-five. In tuberculous muscular spasm the traction weight must be much smaller. There is not sufficient information in the literature as to the technique, duration, and weight necessary to procure a satisfactory result. The present-day principle is that the optimum of action corresponds to the maximum of weight applied to traction. The author supports a different point of view. He finds that the optimum of action corresponds to a certain minimum of weight. Adhesive plaster is used in applying traction and then a load of only 200–400 grams is attached; this weight is increased by fifty grams daily until evidence of correction of spasm. This is usually reached with a load of about 300–800 grams in children. As soon as the spasm is completely relieved, the weight is gradually decreased by fifty grams daily down to 100–500 grams, after which a plaster cast is applied to fix the results obtained. To procure a mild, steady, and painless increase in weight the author proposes the following method; a small empty pail is attached instead of the traction weight, a receptacle with water is suspended above the empty pail, a rubber tube directs the flow of water from the receptacle to the pail, the flow can be regulated to as many drops as desired. The water drip traction was very satisfactory in tuberculous peri-articular spasm with pain and high temperature.—*Emanuel B. Kaplan, M.D., Bronx, N. Y.*

TIBIALE EXTERNUM AND ITS RELATIONSHIP TO FLAT FEET. M. I. Sitenko. *Orthopedia i Travmatologia*, II, 18, 1928.

The os tibiale externum was discovered first in 1605 by Bauhin, and it was found present in about eleven per cent. of cases. On x-ray examination in the anteroposterior position, it is found in eleven and five-tenths per cent. by Fischer. Three forms are met with: Separate well developed bone, rudimentary form and a conglomeration of small fragments. The union between the os tibiale and navicular bone was either by connective tissue or cartilage and sometimes by bone.

A histological study of the specimen removed by operation seems to indicate a definite tendency to close union between those two bones. There are two hypotheses to explain the etiology and pathogenesis of the os tibiale. One considers it an atavistic remnant, the other sees in the tibiale a product of atypical ossification in the cartilaginous nucleus which in normal cases becomes the tuberosity of the navicular bone. Clinically, the os tibiale is interesting as it may be the cause of pain and functional disturbance of the foot, it may be mistaken for a fracture of the navicular bone and in a great majority of cases it is coexistent with a pes planovalgus. In the presence of the tibiale, the patient complains of a tenderness on the internal aspect of the foot while walking and standing. A more or less prominent elevation is found on the internal aspect of the tarsus, the skin over the elevation being red, and the foot presenting a varying degree of planovalgus. In the author's experience those symptoms were found in twenty cases out of twenty-one with the tibiale present.

The presence of pain in certain subjects and the absence of it in others is explained by the degree of firm union of this bone to the navicular. When the union is firm the pain is absent.

The observation of the author and the cases reported in the literature seem to indicate a definite relationship between the os tibiale and flat-foot. The question is whether the presence of the supernumerary bone is the direct cause of the flat-foot or whether the presence of both is due to some common pathological condition. The observations show that there is no relationship between the degree of the foot deformity and the size of the tibiale. The conclusion of the author therefore points to the second

possibility,—namely, that the pes planovalgus and the presence of the os tibiale are due to the same cause. It may be an expression of atavism. If the tibiale externum is looked upon as an atypical development of the ossification centers, the cause of flat-foot may be sought in the constitutional condition which provoked the abnormal cause of ossification. The character of this constitutional change is the retardation of the ossification. In general, the navicular bone has its nuclei of ossification appear later than in the other bones of the foot. It has, therefore, a longer duration and energy of growth in comparison with the other bones of the tarsus. In cases of retardation of growth in the navicular bone, the duration of its growth becomes even longer than normal and the proportion between the size of the bones of the tarsus is changed; the navicular bone wedges itself between the others causing a flattening of the tarsal arch.

Little attention has been paid to the os tibiale in connection with flat-foot. A closer study is important. The different forms of the os tibiale ought to be looked for in every case of flat-foot and the relationship studied.—*Emanuel B. Kaplan, M.D., Bronx, N. Y.*

Upon a Process for Indicating the Vertebrae. Subcutaneous Introduction of a Metallic Indicator in a Spinal Process. Jacques Calvé. *Presse Méd.*, XXXVI, 1493, Nov. 24, 1928.

The author calls attention to the fact that it is often necessary, in vertebral surgery (vertebral laminectomy osteo-synthesis), to indicate exactly the location of the vertebra which one wishes to reach. It is evident that skin markings are unreliable, for

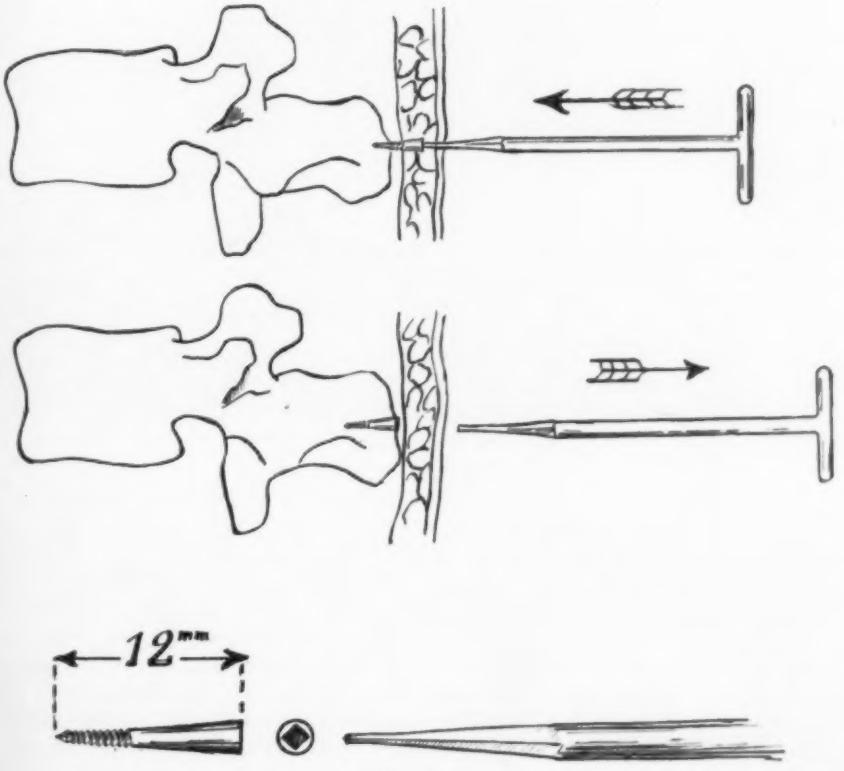

Fig. 1

FIG. 2

once the incision is made and the spinal processes exposed, it is difficult to decide to which spinal process the skin marking applies. To remedy this uncertainty, formerly there has been employed an indicator *in the bone*, which was effected by placing a screw or thumb-tack in the spongy tissue of the spinal process after it had been uncovered.

A radiograph would locate this indicator exactly, and no matter whether it had been placed in the vertebra to be operated upon or above or below that vertebra, the surgeon could operate in all security. It is really a very reliable method, but the placing of the indicator in the open wound has the inconvenience of requiring for itself additional actual preparatory operation. It could, it is true, be performed under local anaesthesia, but it requires careful preparation and rigorous aseptic precautions, which entail a physical and mental strain disagreeable to the patient.

On this account, the author has sought to simplify the technique of placing the indicator, at the same time preserving its accuracy, and, with this aim in view, has had manufactured an indicator and its carrier (Fig. 1). It is made of two pieces: one long, in the form of a sleeve; the other a small rod, with conical trunk which carries on its slender end a sharp point tipped by a screw. These two pieces remain closely united in all movements of the puncture but are easily separated, on the contrary, when the inner piece has punctured into a hard body. The sleeve is then easily withdrawn by a quick pull.

To place the point it is only necessary, after the skin has been anaesthetized in the vicinity of the spinal process, to insert the instrument, as a trocar, perpendicularly to the plane of the back, until it comes into contact with the bone. This contact being established and pressure on the instrument continued, a turning motion is given the sleeve, causing the screw on the point to penetrate the spongy tissue of the spinal process, and this motion is so continued until it has penetrated to about three-fourths of its length. A quick pull on the sleeve then easily disengages it from the indicator and the body. A radiograph will show exactly the vertebra which is marked. This process has been employed with excellent results in a number of cases of Pott's disease, treated by osteosynthesis according to the author's method, which consists of placing a short graft, inserted *only* in the spinal processes of the diseased vertebrae. One can readily conceive that the placing of a *short* graft necessitates a very exact marking of the vertebrae.

Bone Changes in Leprosy. Ralph Hopkins. *Radiology*, XI, 470, Dec. 1928.

The author describes the bone changes which usually are associated with both the skin and the nerve types of leprosy and points out that the most marked and the most rapidly advancing changes occur in the mixed type, presenting both skin and nerve lesions.

The most notable changes occur in the phalanges of both extremities and in the nasal septum, while the bones of the trunk and the long bones of the limbs remain unaffected.

Disintegration occurs in the epiphyses as well as in the diaphyses. The time factor in the loss of bone is widely variable, but most often is very slow. Ten, twenty, or thirty years may elapse while the digits are gradually shortening on account of slow bone absorption. When suppuration with secondary infection occurs the course is much more rapid.

In the nerve type the skin of the hands and feet remains normal, symptoms being limited at first to effects of interference with the nerve function and later to loss of bone.

Actual loss of bone causing the mutilation of hands and feet characteristic of leprosy occurs in several ways. There may be absorption without any external evidence of inflammation or suppuration. The bone loss is followed by the retraction of the soft tissues, remnants of the nails often remaining even when the digit has completely disappeared.

More commonly, necrosis of bone is associated with suppuration, the formation of sinuses and secondary infections. Gangrene may occur. Associated with the sinus leading to necrotic bone is the perforating ulcer which occurs most often on the ball of the foot. These ulcers persist almost indefinitely if the dead bone is not absorbed or spontaneously discharged or surgically removed.

In discussion Dr. Paul A. McIlhenny (New Orleans) pointed out that he was unable to make a differential diagnosis of a leper's hand as distinct from other bony changes. He also pointed out the peculiar absence of arthritis and osteomyelitis in leprosy in spite of the frequent appearance of osteitis.—*C. Mathewson, M.D., Iowa City, Iowa.*

Fractures of the Shaft of the Femur. Willis C. Campbell. *Radiology*, XII, 106, Feb. 1929.

The three chief methods of treatment are:

(1) Traction and suspension, skin or skeletal.
(2) Open reduction with or without internal fixation.
(3) Manual reduction maintained by external fixation.

The author uses the third method. Open reduction, he considers rarely necessary, and unsuitable for routine practice, because of the additional risk. Manual reduction, with immobilization in plaster-of-Paris, he thinks the most reliable procedure; but the plaster work must be good. The main objection is the occurrence of joint changes and limitation of movement from long fixation; but this can usually be overcome by proper follow-up, and the lapse of sufficient time. One hundred per cent. range of movement is not necessary for perfect function.

The paper deals with simple fractures of the shaft. They should be reduced as soon as possible. "Callus once broken up, never forms as rapidly again and repeated reductions and disturbances of callus constitute the most common cause of non-union." Plaster casts may be employed safely before swelling takes place.

Treatment should aim at securing maximum function with minimum trauma to bone and soft structures. The factor of first importance is anatomical alignment. The second is end-to-end engagement of the fragments. "If one-sixteenth of the surface of the fragments can be engaged and persistently maintained, the result will be satisfactory. The x-ray films should show the whole length of the bone. Repeated efforts to secure perfect anatomic and roentgenologic results at the expense of injury to bone and soft structures are very unwise.

Method: The essentials are a fracture table and x-ray beside it. Both legs are put in moderate traction, the one involved in moderate abduction and forty-five degrees thigh flexion, to line up the lower fragment with the upper.

The patient is anaesthetized and the manipulation begun. The fragments are angulated until the ends of the bone impinge, and can be locked, after which the thigh is straightened to normal anteroposterior and lateral alignment. If the fragments slip by one another, the manoeuver must be repeated until there is the definite resistance of impingement of the fragments and locking. Extensive forcible traction may be necessary in order to secure end-to-end apposition of the fragments. Position is checked with fluoroscope or plate, and when the reduction has been made, fixation is secured by plaster extending from nipple line to toes on the affected side, and to the knee on the unaffected side, with a cross-bar between the knees.

Transverse fractures are the easiest to reduce and retain. The most difficult are the short, smooth, oblique fractures. An x-ray is taken at the end of the first week and, if slipping has occurred, a remanipulation is done, with the application of a second cast, with traction. By this technique equally satisfactory functional results are obtained, as in cases where interlocking is secured.

In oblique and in comminuted fractures, we must, at times, be satisfied with one-half to one inch of overlap and shortening, provided the alignment is good. The author believes it is better to have a straight leg one inch short, than to subject his patient to the danger and uncertainty of an open reduction: open reductions do not give one hundred per cent. successful results.

The cast is removed at the end of two weeks in children, and three to four weeks in adults. Angulation can easily be corrected while the callus is malleable and the position of joints changed, thereby preventing stiffness. A second cast is then applied to the injured leg only, and worn another two or three weeks in children, and four to six weeks in adults. After the cast, a brace is worn from two to six months, and physiotherapy instituted.

In seventy-seven cases in children the author reports excellent results in seventy-four; good in three.

In seventy-one adults the results were excellent in fifty-two; good in sixteen; and fair in three.—*Edward N. Reed, M.D., Santa Monica, Calif.*

THE VALUE OF SHENTON'S SIGN IN THE RADIOGRAPHIC DIAGNOSIS OF CONGENITAL FUNCTION OF THE HIP IN EARLY INFANCY. A. Mezzari. *Radiol. Med.*, XV, 13, Jan. 1928.

The author, to the principal radiographic data for the diagnosis of congenital luxation of the hip in early infancy, adds Shenton's sign (the cervical obturator line, interrupted in congenital luxation of the hip), giving to it the greatest value that can be attributed to it.

As one speaks of Shenton positive when the cervical obturator arc is interrupted upward and negative if interrupted downward, the author proposes to designate with the name of Shenton the deviation of this line from the normal since, by itself, it indicates that the femur is not centered. Further, it is admitted that the displacement upward is already considered a sign of positivity. He adds, on the contrary, that Shenton is positive when the displacement is downward. He follows with several indications for the technique of the radiograph in searching for this sign.

Shenton's line is not a pathognomonic symptom of congenital luxation of the hip but may be due to several morbid manifestations.

He calls the attention of radiologists to this symptom, easy to reveal and very useful, inasmuch as it allows early initiation of treatment of congenital luxation of the hip in early infancy.—*Vittorio Putti, M.D., Bologna, Italy.* (*Translation by Murray S. Danforth, M.D., Providence, R. I.*)

A CASE OF MARBLE BONES, DISEASE OF ALBERS-SCHÖNBERG. A. D'Istria. *Radiol. Med.*, XV, 473, May 1928.

Description of a case of marble bones in a patient thirty years old, with evident insufficiency of body development and a tendency to easy fractures. The bone dystrophy affects the entire skeleton. The alterations of the blood picture appear of little importance. The roentgenologic picture substantially reveals itself by an increased opacity. The author, after having assembled the facts known about the disease, shows the difference existing between this infection and osteopsathyrosis. Further, he notes the different grades of roentgenologic transparency that there may be in normal subjects through constitutional differences, varieties in transparency which, carried to the greatest degree, arrive at two opposite pathologic aspects, on the one hand marble bones and on the other osteopsathyrosis. He holds that for the etio-pathogenesis one may think, as in osteopsathyrosis, of endocrine dysfunction and particularly of the parathyroids, which to such an extent play a part in calcium equilibrium, together with the thymus, the thyroid, and the hypophysis which would explain their action with a functional deficiency.—*Vittorio Putti, M.D., Bologna, Italy.* (*Translation by Murray S. Danforth, M.D., Providence, R. I.*)

THE POSSIBILITY OF DIAGNOSTICATING ROENTGENOLOGICALLY DIFFERENT FORMS OF ATLAS-OCCIPITAL UNIONS. E. Ingber. *Radiol. Med.*, XV, 578, June 1928.

Upon the basis of the new classification of Tramontano-Guerritore comprising four well defined groups of atlas-occipital union, the author, by means of five roentgenological pictures, demonstrates the possibility of making an exact diagnosis in the presence of different forms of the union, even in living subjects. The studies of Ingber are not restricted to theoretical and scientific values alone, but on account of the practical necessity of such a diagnosis he predicts that they can be utilized in many clinical cases.—*Vittorio Putti, M.D., Bologna, Italy.* (*Translation by Murray S. Danforth, M.D., Providence, R. I.*)

RADIOLOGY AND CLINICAL MANIFESTATIONS IN THE DIAGNOSIS OF METASTATIC TUMORS OF BONES. A. Rossi. *Radiol. Med.*, XV, 586, June 1928.

The author confirms the necessity of having recourse freely to roentgenological observations in the study of secondary tumors of the skeleton and, illustrating numerous cases from personal observation, arrives at the following conclusions. In patients operated on for neoplasm or who are suffering from neoplasms (and not only in a patient

who may have a painful spine or in whom a spontaneous fracture is revealed roentgenologically), the plate may show a diffuse carcinomatosis of the skeleton where there has been no other manifestation than a slight arthritic syndrome of neuralgic type. It serves as a guide, even when there is lacking a tumor demonstrable clinically, in the search for the primary focus which may have remained latent and unknown for many years. So even when it is necessary to determine whether the condition is neoplastic or inflammatory, the roentgenogram may demonstrate diffuse metastases of the spine without local symptoms. In still other cases there may be the sudden appearance of a crisis with pain simulating an acute process, while on the contrary in the roentgenogram there may be noted the appearance of a metastatic tumor, renal or prostatic, when earlier at operation or in the histological examination, the tumor was considered benign. The author finally demonstrates what has also been shown from roentgenograms of tumor metastases which appeared precociously and even appeared a few days after operation. Such metastases evolve in slow and almost painless mode, so that a roentgenological treatment given after the removal of the tumor may be sometimes blamed for the dissemination of the tumor.—*Vittorio Putti, M.D., Bologna, Italy.* (*Translation by Murray S. Danforth, M.D., Providence, R. I.*)

RESULT OF THE ROBERTSON-LAVALLE OPERATION. J. Lascombe. *Rev. de Chir.*, XLVII, 253, 1928.

The work reported has been done in the service of Professor Delbet, and the author gives these several conclusions as results of his study. The methods should not be used in patients over forty years of age.

It is in the synovial types that the best results are obtained, particularly in a tubercular hydrarthrosis. The operation is contraindicated in the presence of tubercular osteo-articular sinuses. No satisfactory result has been obtained in coxalgia, and this method has been abandoned for this disease and also for the osteo-arthritides of the feet and of other articulations. It appears that this method is not indicated in those benign conditions of arthritis of the knee, this form of arthritis being more easily curable and therefore it is difficult to realize the benefit of the graft.

Lascombe states, in his work, the statistics of Calcagno, published in 1927, at the Société de Chirurgie de Buénos-Aires. These statistics include all the observations, published up to that time, of cases treated by this method of Robertson-Lavalle, and consist of:

Cures	16 per cent.
Improvements	16 per cent.
Non-improvements	20 per cent.
Increased conditions	32 per cent.
Deaths	16 per cent.

—*Jacques Calvé, M.D., Berck-Plage, France.*

A NEW PROCEDURE OF REDUCTION IN SHOULDER DISLOCATION. J. Couniot. *Rev. de Chir.*, XLVII, 420, 1928.

The technique employed by the author is as follows:

General anaesthesia; the patient is placed on the table, a sling under the armpit of the dislocated shoulder; the two heads of this sling are held by an assistant who makes counterextension, and who keeps himself behind the head of the patient. Then the operator pulls the arm directly downward, slightly outwardly rotated with the elbow flexed.

Usually the reduction occurs in a short time and no brutal force is necessary. Often a click is heard, but, according to the author, it is better if the head glides gently into the glenoid cavity.

Postoperative treatment as usual.

The author has employed this method for ten years and it has always given him good results. Even dislocations several days old could be reduced. One had existed for fifteen days.—*A. Steindler, M.D., Iowa City, Iowa.*

Approach of the Humerus by the Internal Route. A. Parcelier and A. Chenut. *Rev. de Chir.*, XLVII, 454, 1928.

These authors report that the avenues of approach to the humerus described in the recent works of operative medicine are grouped into two, the antero-external and the posterior trans-tricipital routes. The first leads to the superior and middle third of the bone, and the second to the inferior third. They feel that these two routes of approach present a common inconvenience. In that of the middle and the inferior third of the bone, it is necessary to find eventually the radial nerve, which obstructs the operative field, to reflect and protect it; for the radial nerve, because of the numerous lateral branches which emerge at this level of the arm, is an organ relatively fixed, and its removal, even though carefully done, may be accompanied by a postoperative radial paralysis. They prefer, in order to reach the two inferior thirds of the humerus, the internal route. It would seem at first glance paradoxical to approach the humerus by the anterior portion, where there are the important groups of muscles and vessels, but on second glance it is noticed that the biceps is easily retracted, and with it the humeral artery and vein, by flexion of the forearm on the arm; that neither the median nor the cubital nerve branches at this level of the arm. They separate more and more as they leave the superior third of the arm. It is sufficient to recognize without retracting them.

The incision should be long, beginning at the axillary angle, immediately behind the inferior border of the pectoralis major, and following then the internal border of the biceps as far as the middle portion of the arm, where it then curves posteriorly to the epitrochlear, which it can easily reach. Having then reflected the superficial vessels and nerves, the incision is made to the biceps, this muscle being drawn to the outside and the mass of vessels and nerves freed at the level of the middle portion of the arm. This last is retracted to the outside, disclosing the intermuscular septum. Immediately behind this and throughout the length of the wound, the sheath of the triceps is incised; the cubital nerve and artery which accompany this are exposed. After having excised the internal wall of the intermuscular septum, the humerus is reached. The bone can then be denuded behind and in front along two inferior thirds. Below it is easy to free the humerus as far as the epiphysis. This incision is not suitable for the upper third of the bone. The deep humeral vein crosses transversely the humerus at this level. This incision constitutes, therefore, the way of choice to treat the osteosynthesis or fractures of the two inferior thirds of the shaft of the humerus.—*Jacques Calvé, M.D., Berck-Plage, France.*

Fractures of the Condyles of the Tibia. L. Moreau. *Rev. d'Orthop.*, XV, No. 3, May 1928.

The author reports twenty-two cases: nine of fracture of the external condyle, two of the internal, five of both condyles, four gunshot fractures of the external and two of the internal condyle.

Of the fractures of the external condyle, six were caused by indirect force (fall upon feet, torsion of the knees), and three by direct force (fall upon the knee, crush by automobile). The symptoms are dominated by hemarthrosis and swelling; suffusion of the limb is not a constant sign. The valgity of the knee, if not immediately apparent, can be brought out by passive abduction movement. In all cases, pressure upon the articular line elicited pain. Crepitation and abnormal mobility of the fragment are usually absent. There is absolute functional impairment; weight-bearing is impossible.

The treatment is simple. The fluid in the joint was removed by puncture, once by arthrotomy. In some cases repeated punctures were necessary because the joint following premature mobilization filled up again. In one case, the Willems treatment was instituted after the first few days and, in spite of painful joint, complete physiological range of motion was obtained. All cases were immobilized in splint or plaster. After a number of days, varying with the particular joint, massage and active exercises were added.

The results were as follows: two very good results, without valgus deformity, good motion; after puncture, compression bandage, continued traction, at the end of two months. Two excellent results after one month from puncture and Willems treatment. After simple immobilization: one normal, one satisfactory functional result with slight and moderate genu valgum; three very good functional results without deformity.

The fractures of the internal condyle are less frequent. They occur by fall with the knee in adduction. Both cases reported were caused by indirect violence. The fracture separates completely the internal condyle and reaches into the metaphysis. The symptoms are analogous to those of the external condyle fracture except that they are localized at the internal aspect of the joint. The treatment of the two cases consisted in simple immobilization without puncture. The results after two months were good in the first case and in the second there remained a certain varus deformity and walking was somewhat painful; flexion was not possible beyond forty-five degrees.

In fracture of both condyles (five cases) the treatment consisted likewise in plaster immobilization without puncture; in two cases continued traction was applied. The results were satisfactory, though not as complete as in fracture of a single condyle. Slight lateral mobility, swelling, joint creaking, moderate restriction of the range of motion were observed.

In gunshot fractures of the condyles the results were satisfactory except in cases of severe infection of the knee joint resulting in ankylosis; and in another case of infection, amputation was necessary.—*A. Steindler, M.D., Iowa City, Iowa.*

Divulsion of the Humeral Condyle. André Sicard. *Rev. d'Orthop.* XV, 340, July 1928.

This is a question of an isolated fracture of the condyle of the humerus, which is a rare variety of fractures of the elbow, and has no relation with the classical fracture of the external condyle, since it leaves in place the epicondyle and does not involve the articular area to the outside of the external edge of the trochlea. This fracture is only seen after fifteen years of age or a little less; the epiphyseal area of the condyle is not united to the diaphysis. The fragment is entirely intracapsular and may be turned either in front, as in the case reported, or posteriorly and is lodged between the olecranon and the radial head. The clinical diagnosis is extremely difficult. Generally there is but little functional trouble, and it is only by the radiograph, particularly the radiograph taken in profile, that one is able to determine the definite diagnosis. The only treatment is that of extirpation of the fragment.

The best route of entrance is an external route, which allows the direct approach to the fragment and avoids the nerve, if care is taken to reflect it to the inside of the long supinator and to keep close to the bone. This is the technique which the author has used. It is necessary to mobilize as rapidly as possible after the operation,—three days, if possible.

The author insists on the necessity of recognizing this rare traumatic lesion. Recognized, it is easy to treat and the results are excellent; not recognized, it leads to a permanent interference of the function and of the movements of the elbow, from which condition the recovery is very difficult.—*Jacques Calvé, M.D., Berck-Plage, France.*

Coxalgia and Osteochondritis of Hip. E. Iromann. *Rev. d'orthop.*, XV, No. 5, Sept. 1928.

There is no radiological sign which in itself permits a distinction between osteochondritis and tuberculosis of the hip with any degree of certainty, before the appearance of fragmentation. Condensation of the epiphysis, flattening, atrophy and the broadening of the articular space are signs in favor of osteochrondritis, especially when associated with appropriate clinical symptoms.

The x-ray findings in hip disease are much less characteristic outside of definitely destructive lesions and well limited foci. None of them are absolutely pathognomonic. The so called *"pincement articulaire"* has a certain value when present but it is incon-

stant and rarely a precocious sign. In doubtful cases, the absence of positive signs of osteochondritis will turn the diagnosis toward hip disease, but one must also keep in mind that there are anomalous types of osteochondritis, and a definite diagnosis will not be possible until a certain time of observation has elapsed.—*A. Steindler, M.D., Iowa City, Iowa.*

X-RAY IN TREATMENT OF FRACTURES. W. K. West. *Southern Med. J.*, XXI, 1011, Dec. 1928.

By case reports he shows the value of thoroughness in the use of x-rays. The cases are divided into three groups: Group I shows results which follow the failure to have x-rays taken. Group II shows cases in which x-rays were taken but for some reason the findings were not absolutely definite, or properly interpreted. Group III includes cases showing the necessity of progress pictures taken at intervals during the treatment of fractures. Great care should be used in keeping the films as a permanent record as they are of great value in medico-legal and compensation cases.—*F. G. Hodgson, M.D., Atlanta, Ga.*

OPERATIVE LENGTHENING OF THE FEMUR. L. C. Abbott and C. H. Crego. *Southern Med. J.*, XXI, 823, Oct. 1928.

Abbott has performed the bone lengthening operations on twenty-six cases, eighteen on the tibia and fibula and eight on the femur.

The fundamental principle is the gradual and continuous skeletal traction following the osteotomy. The maintenance of the fragments in accurate contact and alignment is essential.

A full description of the component parts of the apparatus is given. The steps of the operation; the application of the apparatus and the postoperative lengthening are fully detailed.

Complete reports of eight cases successfully treated are appended.—*R. Breitman, M.D., Iowa City, Iowa.*

THE OPERATIVE TREATMENT OF TRAUMATIC ULNAR NEURITIS AT THE ELBOW. Harry Platt. *Surg. Gynec. Obstet.*, XLVII, 822, Dec. 1928.

In the treatment of the milder cases conservative measures often suffice, that is, complete immobilization of the elbow to prevent friction and pressure. This is true of the average ulnar neuritis associated with recent fracture of the humerus. In the more severe and persistent cases operation is advised. For late ulnar palsy after elbow fractures and for neuritis due to recurrent dislocation, operation is always the method of choice. In incomplete lesions of this nerve at the elbow an ideal neurolysis is available by means of anterior transposition. The technique of transposing this portion of the nerve to the front of the internal condyle of the humerus is described in detail.—*R. W. Billington, M.D., Nashville, Tenn.*

AN OPERATION FOR ANKYLOSIS OF THE HIP JOINT. Percy W. Roberts. *Surg. Gynec. Obstet.*, XLVII, 841, Dec. 1928.

This operation is based on the "slot and key" principle of fixing a wheel or gear to a shaft. After exposing the superior-posterior aspect of femoral head and acetabular rim a sort of sliding graft from the adjacent ilium is placed in a slot extending across the joint line into the femoral head. The graft is driven in firmly so as to lock the femoral head in the desired position for best function of the limb. A plaster spica is then applied, to be worn for ten weeks. One case is reported. The author believes that in cases of osteo-arthritis of the hip this is a simpler and safer procedure than other operations devised for this condition.—*R. W. Billington, M.D., Nashville, Tenn.*

TREATMENT OF FRACTURES WITH THE EQUILIBRATED SWINGING TRACTION APPARATUS. H. P. Wijnen. (Amsterdam.) *Surg. Gynec. Obstet.*, XLVIII, 90, Jan. 1929.

At present the traction apparatus devised by Dr. Metz of Amsterdam is known

throughout the world as the "Balkan frame" method. Dr. Metz first used this frame in 1898 and described it in 1903. A Dutch ambulance unit brought it to Serbia where it drew the attention of the French and Americans and was adopted under this name. The original method is illustrated and described. The different alterations of the original method and the one now used in Dr. Noordenbos' Clinic are presented in great detail in a sixteen-page article. The technique as applied to all the long bones of the extremities cannot be stated in a brief abstract, but notable points are that skeletal traction by the Steinmann pin is used in all cases and that slings are used to support the limbs instead of the Thomas, Hodgen, and similar splints.—*R. W. Billington, M.D., Nashville, Tenn.*

FRACTURES OF THE LATERAL TUBEROSITY OF THE TIBIA WITH DISPLACEMENTS OF THE LATERAL MENISCUS BETWEEN THE FRAGMENTS. W. R. Cubbins, A. H. Conley and G. S. Seiffert. *Surg. Gynec. Obstet.*, XLVIII, 106, Jan. 1929.

In fractures of the lateral tuberosity, if the fragments are widely separated, the lateral meniscus is sometimes detached at its curved border and displaced downward between the fragments so that they cannot be approximated except by means of open operation. Two such cases are reported. It is thought best not to excise the meniscus but to suture it back in place. Wood screws are used to hold the bone fragments together. Careful passive motion is begun in two to four weeks, a removable cast being used as support for eight weeks.—*R. W. Billington, M.D., Nashville, Tenn.*

DUPUYTREN'S CONTRACTION; WITH A DESCRIPTION OF THE PALMAR FASCIA, A REVIEW OF THE LITERATURE, AND A REPORT OF TWENTY-NINE SURGICALLY TREATED CASES. A. B. Kanavel, S. L. Koch, and M. L. Mason. *Surg. Gynec. Obstet.*, XLVIII, 145, Feb. 1929.

This forty-five-page article is an elaborate presentation of the subject, including a report of results in twenty-nine cases, fully illustrated. Following is the authors' summary:

Twenty-nine cases of Dupuytren's contraction are reported which have served as an incentive for a careful study of the normal fascia of the hand, and an opportunity for observing the unusual changes which it undergoes in Dupuytren's contraction. Seven of these cases had been operated upon previously, some of them more than once, and in each case the condition had recurred. The results observed in such cases, and the results obtained in the cases operated upon by the writers have emphasized the importance of:

1. Wide excision, not only of the contracted fascia, but of all its attachments to the skin, the interfascial septa, the volar interosseous fascia, the metacarpal bones, and the phalanges. Although in such an operation apparently normal fascia may be removed, this is not considered a disadvantage but rather an added guarantee against recurrence.

2. Careful dissection and elevation of the skin to avoid trauma and subsequent necrosis.

3. Painstaking effort to avoid injury or division of the digital nerves and blood vessels which are frequently imbedded in the bands of fibrous tissue which draw the fingers into flexion.

4. Excision of skin that is hopelessly involved, and replacement of the excised skin by a free, full thickness graft rather than attempting to bring together wound edges under tension.

5. In long standing cases with marked contraction of the fingers, excision of the head of the proximal phalanx and shortening of the extensor tendon of the affected fingers through a dorsal incision (Hutchinson's operation).

6. Active movement of the fingers and hand as soon as the operative wound is soundly healed.

If treated in such a manner complete restoration of function may reasonably be

hoped for, although cellular infiltration of the hand and partial anaesthesia and stiffness of the fingers may persist for a considerable period of time after the operation.—*R. W. Billington, M.D., Nashville, Tenn.*

EXTRA-ARTICULAR IMMOBILIZATION OF THE HIP JOINT. H. C. Schumm. *Surg. Gynec. Obstet.*, XLVIII, 112, Jan. 1929.

The author brings forth another method of extra-articular fusion of the hip of which he has done nine cases with good results.

The operation consists of making a periosteal trap-door flap on top of the trochanter and a flap of the ilium, with the base upward, then taking a bone graft from the shaft below the trochanter to put in this prepared area. The graft is one-fourth of the circumference of the shaft and is of full thickness. The author corrects the deformity at time of operation with a Gant osteotomy if it is necessary.

The patient is allowed up on crutches in four months, and all support removed at the end of six to eight months. In cases without an osteotomy, a bivalved cast is made before operation.—*H. Goldberg, M.D., Iowa City, Iowa.*

DIE BEDEUTUNG DER MUSKELHÄRTEN IN DER ORTHOPÄDIE (The Significance of Muscle Indurations in Orthopaedics). Fritz Lange. *Ztschr. f. orthop. Chir.*, L, 405, 1928.

In the opinion of the author the importance of these changes, first described by Kleen in 1895, has been neglected. Müller in 1914 described four abnormal findings in rheumatic muscle: (1) hypertonus, (2) swellings of varying size, softer in consistency than the surrounding muscle, (3) hardening of groups of muscle fibers, palpable as rubber band-like structures, (4) nodules located deep in the muscle insertions. Schmidt in 1918 denied these findings, but Lange finds corroboration even in Cornelius, an opponent, who attempted in 1925 to explain these findings on a basis of hyperaesthetic head zones. However, Lange points out that the masses in the muscles do not disappear even under deep anaesthesia, and therefore, do not represent simple spastic fibers. He reports examination of a large number of patients and finds spindle-shaped masses, one-fifth of a centimeter in diameter, in chronic and acute strains and rheumatism. They appear in the overacting glutei of unreplaced congenitally dislocated hips and tubercular hips in the trapezius and erector spinae of scoliotics, in writer's cramp, and in the overworked muscles in spastic paralysis. In the last, the masses are distinguishable from the spastic muscle. Many are found in sciatica and lumbago.

In examining for their presence the skin of the patient should be lubricated with liquid paraffin to prevent reflex contractions. The masses when found are very sensitive, and can be definitely pushed about in the muscle with the examining finger.

Treatment consists of a rather vigorous massage whose aim is to break down these masses. Centripetal strokings are followed by increasingly heavy circular movements with the tips. As a rule tears are elicited on the first treatment which lasts from ten to fifteen minutes and ecchymoses are present the next day. These ecchymoses are pathognomonic in spite of the slight histological evidence found to date. Diathermy follows, and is used in intervals between treatments similar to the above. The results are often most striking. After-treatment consisting of massage is self administered.—*J. E. Milgram, M.D., Iowa City, Iowa.*

ARMAMPUTATIONSSTÜMPFE UND KUNSTARM (Arm Amputation Stumps and the Artificial Arm). Th. Kölliker. *Ztschr. f. orthop. Chir.*, L, 431, 1928.

Long experience with artificial arms demonstrates that despite all the attention lavished on the construction of the prosthesis, the arm is worn seldom and most often used only for aesthetic reasons. The Sauerbruch artificial arm fared no better. Only nine and five-tenths per cent. used it while at work. Seventeen per cent. used it regularly; thirty-eight per cent. irregularly, and forty-five per cent. not at all. Of those who wore it forty and five-tenths per cent. used it merely to conceal the defect.

For everything he possibly can the patient prefers the use of his own stump to an artificial arm. It is for this reason that, at the time of amputation, every care should be taken to preserve maximum function at the level amputated. While the Krukenberg arm works well, its monstrous appearance, unfortunately, makes it unpopular.

In amputation through the upper arm, the inner aspect of the stump must be free from scars as the stump will be applied to the thorax in grasping.

At the elbow, extra-articulation should be avoided if possible, as even the shortest stump can be utilized in a Sauerbruch prosthesis for short arms which will permit strong finger grip. The flap should come from behind. The medial humeral epicondyle should be removed in anticipation of pressure complaints over this bony prominence.

In amputating the forearm, the antero-external aspect should be provided with a scar-free surface, as weight-carrying will traumatize this surface most. The radius and ulna should be divided at different levels, and above all, pronation and supination must be retained, for this is of the greatest use either with or without a prosthesis. Wherever permissible the Krukenberg and Walcher procedures are to be performed.

As far as extra-articular amputation at the wrist is concerned, the author, as a rule, performs an amputation low in the forearm, as otherwise it is difficult to fit an artificial hand which will give an extremity of the same length as the good arm. A volar flap is recommended.

In general, one should decide at the time of amputation of the arm, whether the stump is destined for a prosthesis or not and plan accordingly.—*J. E. Milgram, M.D., Iowa City, Iowa.*

BEITRAG ZUR KENNTNIS DER OSTEOGENESIS IMPERFECTA TARDA (OSTEOPSATHYROSIS IDIOPATHICA). (Contribution to Our Knowledge of Osteogenesis Imperfecta Tarda.) W. Menckhoff. *Ztschr. f. orthop. Chir.*, L, 689, 1928.

The author reports in detail four cases of the disease. No hereditary influence was discernible. The curvature of the bones was referable more to bending than to fractures. Only one had blue sclerae. Two had a tinge, not unusual in children, and one had white sclerae. Genital hypoplasia was present in two, hyperplasia in none. In one case spontaneous fractures preceded by pain occurred in autumn and spring as a rule. Otherwise the disease is unaccompanied by pain. The fractures healed normally or approximately so in four to six weeks. However, eventually, repeated fractures at the same site ended in pseudarthrosis which did not heal after repeated bone grafting operations.

Treatment was successfully carried out in so far as osteotomies and apparatus enabled them to be placed upon their feet. Medical treatment aimed at the osseous disease was entirely ineffective. Histological studies revealed nothing new, but are well presented. The bibliography appended represents the recent German contributions to the subject and serves to bring Frangenheim's classic compilation to date.—*J. E. Milgram, M.D., Iowa City, Iowa.*